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Group Report**1964-38****Computer Programs
for
Haystack Servo Testing****L. D. Massey****21 July 1964**

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
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COMPUTER PROGRAMS FOR HAYSTACK SERVO TESTING

L. D. MASSEY

Group 62

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LEXINGTON

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ABSTRACT

The facilities available for testing the performance of the Haystack servo system using the Univac 490 digital computer are described. Sine, step, impulse, and polynomial inputs may be applied to the system. Operating instructions and examples of inputs and outputs from the various programs are given. A fairly detailed description of the program logic is provided and complete listings are included for all non-library programs.

Accepted for the Air Force
Franklin C. Hudson, Deputy Chief
Air Force Lincoln Laboratory Office

COMPUTER PROGRAMS FOR HAYSTACK SERVO TESTING

I. INTRODUCTION

It is intended that the Haystack antenna be primarily directed by the 490 digital computer. When the digital control system is first connected to the antenna and actual motion is attempted, it will be important to study the response characteristics of the antenna servo system. It will also be desirable to periodically check this response over the useful life of the facility. Although the system response can be checked by analog techniques, and although the normal "Pointing" program also provides some checking, it was felt that a special effort was justified. Specifically, it appeared desirable to permit digital generation of special test functions and a detailed digital analysis of the resulting response. For this purpose, a computer program has been written for the Univac 490 which can drive the antenna and which will provide on-line printouts in real time of the input to the servo and the response of the servo. For more detailed checking, the program provides magnetic tape outputs which can be further processed and plotted using the Laboratory IBM 7094 in Lexington.

Probably the most informative viewpoint to take in attempting to comprehend all the ramifications of this system of programs is to consider it as a completely flexible and automatic data-gathering system. It is not the function of the system to provide analyses of complex aspects of antenna steering kinematics. The function of the system is to provide a perfectly general, systematic, and uniform procedure for automatically obtaining static or dynamic data about antenna behavior under a variety of conditions. The data obtained is in printed, magnetically recorded (digital), or graphed form and is, therefore, suitable for immediate analysis by manual or mechanical computation procedures. In particular, the magnetic tape records are acceptable to the IBM 7094 computer for further computation.

This testing is performed by entering through the on-line console specifications for independent motions to be executed by the azimuth and elevation drive systems. One is free to specify dynamic tests with sinusoidal oscillations, step and impulse functions, and up to fifth order polynomial trajectories. A static positioning test is also available. The antenna servo response to these signals is automatically recorded on magnetic tape and simultaneously printed on the on-line printer. The magnetic tape can be further processed by the IBM 7094 system to produce graphs of the response (via the Calcomp plotter) and BCD tapes suitable for printing or input to FORTRAN programs.

The remainder of this report discusses the testing package in increasingly greater detail. First, typical examples of the data generated are exhibited. Detailed instructions for system usage follow, terminating in a detailed documentation of the mechanical logic of the computer programs. Examples and discussions tend to be in terms of the particular aspect of the problem with which our group is associated; however, this aspect is extremely general itself.

II. SYSTEM DESCRIPTION

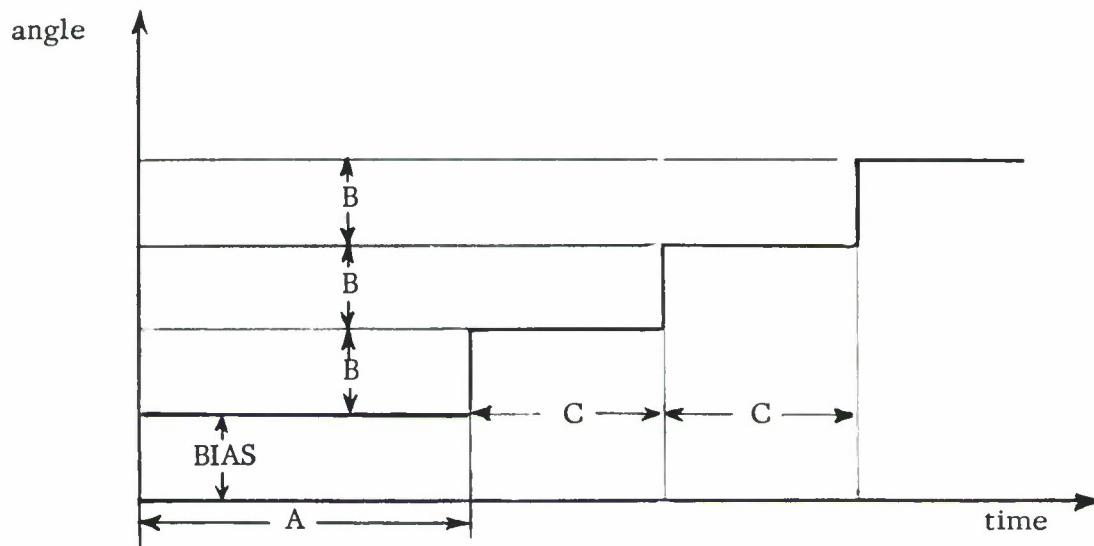
In using the system, one first performs certain routine operations which bring the program into the Univac 490 computer. When the program is started, it makes a few basic inquiries and then leaves the operator free to specify his requirements. The specifications of a run permit complete freedom in selecting starting positions (biases) on both axes. Nominally, the experiment begins at a specified time and lasts for a specified duration, with motions commencing when the antenna has stabilized at the specified starting point. One always has full and independent control over the amount of data recorded on magnetic tape and on the on-line printer. The mathematical functions which define the drive functions (see below) can be independently specified on both axes. An experiment can be interrupted at any time without losing any data previously obtained.

Five driving functions are available on each axis. AZNOT and ELNOT simply hold the antenna fixed at a specified azimuth or elevation bias. AZSINE and ELSINE produce a sinusoidal oscillation about the bias angle with independently specified amplitude (in degrees), and frequency (in cycles per second). AZPOLY and ELPOLY cause the antenna to track any trajectory that can be specified parametrically in time by an equation of the fifth order, or less.

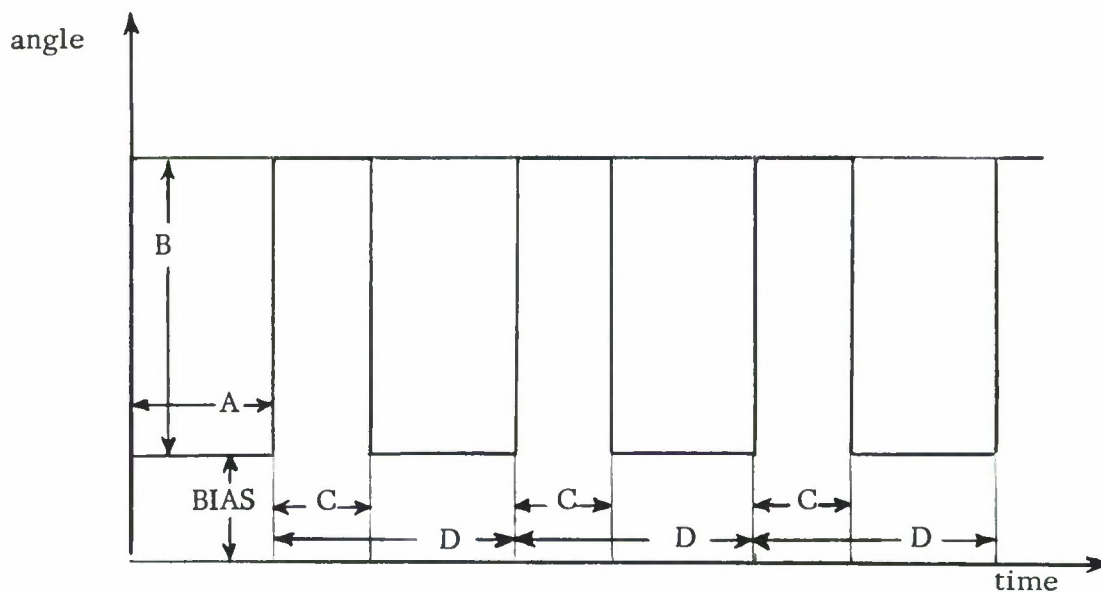
$$\text{AZIMUTH} = a_0 + a_1t + a_2t^2 + a_3t^3 + a_4t^4 + a_5t^5 + \text{BIAS}$$

Positive or negative values may be entered for the coefficients.

To test transient response, two types of functions are available. AZSTEP and ELSTEP provide a positive or negative-going staircase function of time, starting at the specified bias = STEP(A, B, C) + BIAS:



The parameter B may be negative, thus providing the negative-going function. The other test available is provided by AZIMPULSE and ELIMPULSE which produce a positive or negative directed series of impulse, also beginning at the specified bias: $\text{IMPULSE (A, B, C, D) + BIAS}$:



Again, the parameter B may be positive or negative.

Once an experiment has been specified by the operator, the Univac 490 computer program generates instructions for the antenna servo system at the standard rate of 250 times per second. The data is transferred to the servo system in exactly the same fashion as the data is handled in the standard "Pointing" program.

In real time, two forms of output are produced; hard copy on the on-line, high-speed printer and IBM format magnetic tapes for further processing at the 7094. It is anticipated that the line printer output will be used for more simple testing, but that the detailed analysis may be useful for trouble analyses or for graphical presentation of results. Due to the speed limitations on the on-line printer, it is not possible to obtain by that method the full rate of 250-point-per-second data; the maximum output rate of the line printer in this program is 10 lines per second (or a sampling of the servo input and output at $1/25$ of the actual data transfer rate). The magnetic tape recordings, of course, provide complete data on every point in the full rate.

The magnetic tapes generated by these tests contain a record of the signal applied to the servos and the position of the axes when the signal was applied, along with the time of application. A special program on the 7094 will convert these tapes to a BCD format suitable for printing or input to another 7094 program. Another 7094 program produces graphs of selected material directly from these tapes with completely labeled and calibrated axes. These graphs are drawn by the Calcomp plotter via the IBM 1401.

III. OPERATING INSTRUCTIONS FOR HAYSTACK TESTING PACKAGE

The testing facility for the Haystack antenna servo system consists of three programs:

Program I to run on the Univac 490 computer which supplies commands to the servos and records their responses.

Program II to run on the IBM 7094 to convert and print the output of Program I.

Program III to run on the IBM 7094 to plot the output of Program I on the Calcomp plotter.

A. Program I - Univac 490 Testing Program

The following is an exact explanation of one way in which the antenna testing program (ANTENATEST) may be operated so as to take full advantage of all its features. This does not represent the full generality of the system since particular operations are here prespecified when a number of different but effectively equivalent alternatives exist. Accordingly, this should prove particularly useful to those persons who are relatively unacquainted with the testing system and/or the Univac 490.

1. Mount the following magnetic tapes on drives as indicated:
 - a. (Logical 0) SPURT III system tape

- b. (Logical 1) Any blank tape
- c. (Logical 2) The ANTENATEST 321 tape

2. Press the "CHANNEL CLEAR" buttons on the tape adapter cabinet and on the printer control cabinet.

3. On the maintenance panel of the computer, depress the toggle switches marked "OPERATION," "MASTER CLEAR," and "BOOTSTRAP" in that order.

4. The console printer will type "READY." You type:

LD ☐ S2 ☐ 321 ☐ 10000 ☐ S

The character "☐" is marked "SPEC" on the keyboard.

5. Next, the console printer will again type "READY." You type:

PS ☐ 10000 ☐ S .

6. The console printer types:

THIS IS THE ANTENNA TESTING PROGRAM.

DO YOU WISH TO HAVE OUTPUT ON THE ON-LINE PRINTER.

IF SO, HOW OFTEN.

You may reply:

NO ☐ S

if you wish to have no on-line printing, or

YES ☐ XXX ☐ S

where "XXX" is a decimal integer of exactly three digits in the range 999 to 025. If you type in a number N, exactly 1/Nth of the data generated in positioning the antenna will be printed on the on-line printer. The output may be obtained in octal or decimal form. The decimal listing contains seven columns. See Fig. 2. From left to right, the first column is time, in seconds, from the beginning of the test. The second is the azimuth position generated by the computer. The third is the current azimuth position of the antenna. The fourth is the difference between these figures. The fifth, sixth, and seventh repeat these functions for the elevation coordinate. All angles are printed in degrees, truncated to four decimal places. In octal mode, 9 columns are printed. See Fig. 3. The first, second, and fifth are identical to those in decimal mode. The third column is the azimuth command to the antenna in octal. The fourth column is the azimuth position of the antenna in octal. The sixth and seventh repeat the third and fourth for elevation. The eighth and ninth are the octal differences in azimuth and elevation between the command and the position. Printing mode may be selected in mid-run or changed by typing the characters "O" for octal mode and "D" for decimal

mode. Printing may be stopped and restored in mid-run by typing the characters "S" for stop and "P" for print. None of these characters will be printed at the console.

7. The console printer types

TYPE TEST IDENTIFICATION

You may type a label up to 30 characters in length and terminated by a .

8. Next, the console printer types

TYPE TEST PARAMETERS

You have two options. You may type ".. " (option a), or you may type a parameter line (option b).

9 a. If you typed ".. ," the console will ask two questions. First, it asks:

DO YOU WISH TO CONTINUE

This should be answered YES or NO . Next it will say

DO YOU WISH TO REWIND OUTPUT TAPE

Again, answer YES or NO . If you answered YES to the second question, the tape on B will be rewound with interlock and must be changed. If you answered YES to the first question, you will be back at step 6. If you typed NO, you will be back at step 5.

9 b. If you elect to enter data for a new run, it must be in the form described at the end of this discussion. As soon as you type at the end of the line, the actual test begins. If you enter an inadmissible line, an appropriate remark will be typed and you will be returned to step 8.

10. After a 15-second delay for aiming, the computer will generate the specified function and supply it to the antenna. After specified delays, data will be printed on-line and written on magnetic tape.

11. If you decide, in mid-run, to enter a new set of parameters before the full run is complete, type . You will be returned to step 7. All data recorded on tape to this point will be usable. If you let the run continue for its specified duration, you will still end up at step 7.

Note: It is important to plan your runs to take maximum advantage of identical constants in printing rate, since the only way to change the rate is by the jump from step 9 a. to step 6, a fairly time consuming operation.

Format for a Line of Parameters

1. Type the azimuth bias in degrees as a signed or unsigned decimal number (fractional places allowed).
2. Type a comma.
3. Repeat 1 and 2 for elevation bias.
4. Type the number of seconds delay desired before recording output as a positive decimal integer. Zero is not acceptable. Type a comma.
5. Repeat 4 for the duration of run desired.
6. Type the number of 4 ms intervals between successive tape recorded data points as a positive decimal integer. (5 intervals = 20 ms between recorded measurements)
7. Type the name desired for azimuth drive function. It must be AZNOT, AZPOLY, AZSINE, AZSTEP, or AZIMPULSE. Type a comma.
8. Repeat 7 for elevation. The names are ELNOT, etc.
9. Type the arguments, separated by commas, for the azimuth function.
10. Repeat 9 for the elevation function. At this point, every field in the line should end with a comma, including the last field.
11. Type a (s) . The computer should now be running.

If a field is simply entered as a comma with no prefixed number, or function name, the value from the preceeding test will be used. In the case of the first test, do not trust this value to be zero.

Function Arguments

NOT:

1. Selecting this function causes the antenna to remain stationary at the given bias angle. No input parameter is used, but a single comma must be typed in the parameter field (see Fig. 1).

POLY:

1. The nth field in the argument list for a polynomial function is the coefficient a_{n-1} in:

$$\Delta \text{ } \text{\textcancel{x}} = a_0 + \frac{a_1 t}{10} + \frac{a_2 t^2}{100} + \frac{a_3 t^3}{1000} + \frac{a_4 t^4}{10000} + \frac{a_5 t^5}{100000}$$

where t is given as elapsed time in seconds and the Δ angle is in degrees.

SINE:

1. Frequency of oscillation in cycles/sec. (f).
2. Amplitude of oscillation in degrees (A).

$$\Delta \theta = A \sin (2\pi ft)$$

STEP:

1. Time for first step (seconds).
2. Height of steps (degrees).
3. Repetition time (seconds).

IMPULSE:

1. Time for first impulse leading edge (seconds).
2. Height of impulses (degrees).
3. Duration of impulse in seconds.
4. Repetition time, leading edge to next leading edge (seconds).

B. Program II - IBM 7094 Print Program

This program reads the files of data from the 490 output tape and prepares a BCD tape (for printing on the 1401). For each file on the 490 tape, a print file is generated on the BCD tape. Each file contains an identifying label, in addition to the edited data obtained from the 490 and converted to decimal numbers of degrees.

Figure 4 shows a listing of a control deck that was used for printing the output tape produced by the console communications of Fig. 1. The first card gives the number of files to be listed in columns 9 and 10. The seven remaining cards (one for each file) give the editing factor for the corresponding files. If this number is n, every nth point on tape will be printed.

Figure 5 shows a page of the output produced by the specification of Fig. 4 and the tape from the 490.

The first line is simply the run label that was typed in on the 490. The columns are (from the left):

1. Time elapsed in seconds from first application of drive function to servos.
2. Azimuth (in degrees) output to servos.
3. Elevation output to servos.
4. Azimuth input from encoders.
5. Elevation input from encoders.
6. Difference of columns 2 and 4.
7. Difference of columns 3 and 5.

For brevity, only a single page of output is reproduced here; however, this would normally be quite copious.

This IBM 7094 program is a relocatable column binary deck that must be run under FMS control. The deck is labeled "Haystack Test Print." The 490 output is mounted on A7. The print tape is A6. The control data deck is placed behind the binary deck for the run.

Control Deck:

1st Card: Col. 1 = *, Cols. 7-10 = DATA

2nd Card: Number of files to process in Cols. 1-10 as a right justified integer.

Rest of Deck: One card per file to process, giving, in Cols. 1-10, the frequency of selecting points for printing as a right justified decimal integer (1 = every point, 2 = every 2nd point, etc.).

C. Program III - IBM 7094 Plot Program

This program reads files of data from the 490 tape as they are addressed by their file labels. It prepares, as output, a BCD tape for driving the Calcomp plotter (via the 1401). The format of the graphs produced is quite flexible.

Figure 6 shows a listing of a control deck that was used to plot some of the information from the output tape produced by the console communications of Fig. 1. The first card gives the number of plots to be made in Cols. 9 and 10. Each plot is specified by a pair of cards. The first card of each pair contains, in Cols. 1-30, the label of the file from which the plot is to be made. The second card of each pair contains six variables, in fields ending in Cols. 10, 20, 30, 40, 50 and 60, respectively. The first of these provides selection of the coordinate to be plotted (0 means plot azimuth; 1, plot elevation). The second field specifies the time, in seconds, between plotted points, while the third and fourth fields state, respectively, the lower and upper limits of the time axis in seconds. The fifth field gives the physical length of the graph in inches (measured along time axis). The sixth field specifies what data is to be plotted for the given file and coordinate. This appears as a one-digit code. For more detailed discussion, see p. 10.

Figures 7 through 14 are some graphs produced by the data cards in Fig. 6. Note that the file label is neatly plotted above the graph and that the fixed length of the vertical (angle) axis (5 inches) makes the graph suitable for full-size reproduction on

standard 8-1/2" x 11" paper. All parameters of the graphs can be seen to conform to the relevant specifications of Fig. 6. Since the antenna was not connected to the computer at the time these tests were made, Figs. 8, 10, and 14 show errors due to delays in the in-out system, but do not show true servo errors.

This IBM 7094 program exists as a relocatable column binary deck that must be run under FMS control. The deck is labeled "Haystack Test Plot." The 490 output is mounted on A7. The plot tape on A6. The control deck is placed behind the binary deck for the run.

Control Deck:

1st Card: Col. 1 = *, Cols. 7-10 = DATA

2nd Card: Cols. 1-10, right justified decimal integer, number of graphs to be plotted, same as number of pairs of cards which follow.

Rest of deck consists of a pair of cards for each graph to be drawn. Of each pair:

2n + 1st Card: Cols. 1-30, left justified, the exact label given to the file to be plotted when that file was generated on the Univac 490.

2n + 2nd Card: Col. 10 = 0, plot azimuth; 1, plot elevation.

Cols. 11-20 = time interval between data points to be plotted, in seconds, as any decimal number, right justified.

Cols. 21-30 = lower time limit of plot, in seconds, as any decimal number, right justified.

Cols. 31-40 = upper time limit of plot, in seconds, same format.

Cols. 41-50 = length of time axis on graph, in inches, same format.

Cols. 60 = specifies what combinations of data to plot, with following interpretation:

0, nothing plotted

1, only input

2, only output

3, input and output

4, only error

5, input and error

6, output and error

7, input, output, and error

IV. INTERNAL DETAILS OF THE UNIVAC 490 ANTENNA SERVO TESTING PROGRAM

The three programs will again be discussed separately. This material should be read with reference to the program listings in the Appendices.

A. Program I - Univac 490 Testing Program

This program supplies azimuth and elevation coordinates to the antenna servo every 4 ms in accordance with input specifications. The time-dependent variation of the coordinates from a constant bias is calculated through a subroutine for the function used. The manner of linking subroutines to the program will be described.

Execution of the program begins at ANTENTRY. An initial remark is typed. By use of the subroutine SINEFUNCS a table of the sine function containing 2048 values is calculated and stored at location SINTBL. This corresponds to a density of 512 points per quadrant. The table is subsequently used by AZSINE and ELSINE for driving the antenna.

Next an interrogative remark is typed out requesting the parameters of on-line printer output. The first character typed in is examined to determine if it is a "Y" or an "N". If it is an N, the program jumps to INTCLKTEST after clearing ZXNLINEIND. If it is a Y, the 5th, 6th and 7th characters are entered as a decimal number, converted to octal, and stored in the lower half of ZXNLINEIND.

The entry at PROGRAM is used to write an end-of-file mark on tape #1 on completion of an operation. INPUTBUF is cleared to receive the run label which is accepted from the console. The label is converted to BCD from field data by FDTOBCD and is written on tape #1. The program now accepts the running parameters.

The line of data is first tested for a double period code ". ." which indicates termination and causes a jump to NOMORE. If this is not present, the line is scanned from left to right and separated at the commas. The fields are stored successively in the areas designated by the low-order halves of TABLE. The operation is terminated by sensing a stop "Ⓢ", and control passes to VIRGULE. The program calls DECON to convert the first 5 variables listed in TABLE to octal with binary points indicated by the upper halves of the corresponding words in TABLE. If a variable is indicated only by a comma, the number in the register is left unchanged; otherwise, the converted number is placed in the appropriate location in CONTBL. When this is complete, control passes to FUNIDLOOP.

FUNIDLOOP compares the bit patterns stored in FAZI and FELE (addressed through TABLE) with the various possible names in FUNCTBL. If the function is

successfully identified, its address and argument count is transferred from the appropriate location in FUNADDTBL to FUNLOC or FUNLOC+1. If the function name cannot be identified, an appropriate error remark is typed out and control is returned to CONINETC.

If no difficulties are encountered, the function arguments are converted by scanning the tables appended to the beginning of each subroutine. The upper half of each word contains the location of the binary point and the lower half the address for storage of the converted variable. If the total field count at the end of this operation does not match the argument counts obtained from the upper halves of FUNLOC and FUNLOC+1, an appropriate remark is typed and control passes to CONINETC. Otherwise, the real time section of the program is initiated at ZKFLDCNT.

AZST and ELST are set equal to the biases of azimuth and elevation in degrees, and these biases are converted to revolutions with a binary point at 19. The time periods specified in the input line are converted to a count of servo I-O cycles (4 ms each). They go into NWAIT, NRUN, and FREQOUT, respectively. A loop on B1 for 3750 cycles (15 seconds) moves the servos to the initial position specified by the input string.

The drive loop is initialized with two index registers (B1 and B4) being used in tandem to count running times longer than 77777_8 cycles. POINTGEN begins the drive loop. It ends roughly at PRINTRET+5. In this loop, the elapsed time in seconds is calculated and stored in THYME; the appropriate azimuth and elevation functions are called and the results (in degrees) stored in CONTBL. These quantities are converted to revolutions and stored in AZIMUTH and ELEVATION. Finally, the computed point is transferred to the servos via DRIVEREAL and index registers are tested to determine appropriate action. Register B5 delays output until the servos can start to track the applied function; i. e. , until the servo response has reached a steady-state condition. Register B2 causes a line of output to be added to the output buffer (through WRITEBUF), with the period determined by FREQOUT loaded into B2. B3 performs a similar function for the on-line printer (transferring control to PRINTER). As mentioned before, B1 and B4 are used together to control the total number of cycles of the loop.

When the loop is finished, whatever remains in a tape output buffer is written out along with a terminal end-of-file mark. The biases in CONTBL and CONTBL+1 are reset to their initial value before the run.

Control is transferred to WRITEBUF if an entry is to be made in a tape output buffer. The output values are obtained from the encoders via ENCODEREAL and the five variables TIME, AZIMUTH, AZOUT, ELEVATION, and ELOUT are assembled into six words so that a blank block of six bits will appear between each word written on tape (this extra byte makes direct reading of the tape on the 7094 possible). The data is assembled into BUFB or BUFA depending on the status of the indicator FIRST. When B6 indicates that 100 lines have been entered, TAPEWRITE is called to initiate the output buffer.

At the end of a tape when a double period has been typed in as an input line, control passes to NOMORE which asks if continuation is desired. A YES or a NO (or a Y or N) may be typed in. The program also asks if the output tape should be rewound or left positioned. Again, YES or NO will be accepted. The indicated operation is performed (rewind with interlock) and control is returned either to MAIN or TOPS (137).

Subroutine TAPEWRITE sets up the channel 13 interrupt location (external) and activates the appropriate buffer to write output in binary high density mode on servo #1.

Subroutine DEGCON divides the contents of the A and the Q separately by 360_{10} to convert degrees to revolutions at a binary point of 19.

Subroutines DRIVE and ENCODE are dummy routines that function through jumps to DRIVEREAL and ENCODEREAL.

TABLE is a list of the addresses of the areas for storing the various input fields separated from the input line. FUNCTBL is a list of the names of allowed drive functions, while FUNADDTBL contains the addresses of the functions and the length of the argument storage list associated with each one.

ELPOLY and AZPOLY are the polynomial generating subroutines. They are each prefixed with a list of the addresses of the six coefficients of the polynomials:

$$\Theta - \Theta_0 = \sum_{n=0}^5 a_n \zeta^n ; \varphi - \varphi_0 = \sum_{n=0}^5 a_{6+n} \zeta^n$$

where $\zeta = (\text{THYME}/10)$, Θ = azimuth in degrees, and φ = elevation in degrees. The variable ζ is stored in THYMEX. Θ_0 and φ_0 are the initial biases stored in AZST and ELST.

Subroutine DECON converts a 12-character decimal numeric field stored in NUMBER to binary according to the placement of the binary point specified in BINPNT. The result is left in ACCUM. Acceptable forms are:

3.1415926,	3,	3.,
+3.1415926,	+3,	+3.,
-3.1415926,	-3,	-3.,

No more than nine numbers may be used in the input field and it must be terminated by a comma. BINPNT may be greater than 31 or negative, if desired; however, it is usually positive and less than 31. This is a general utility subroutine and is transparent to all external and active registers.

FIXTC is the error recovery program for magnetic tape interrupts.

FDTOBCD converts a word in the Q-register from field data to BCD by use of the table BCDTBL. One character at a time is entered into B2 and the appropriate code obtained from the table and appended to ANZ.

SINEFUNCS computes the sine of an angle specified in revolutions, with sign corrected in all quadrants. The sines are actually computed in the first quadrant by the Hastings approximation subroutine SINEFUN. SINEFUN obtains the sine of the fractional revolution stored in the Q-register at B21. The result is left in the Q at B21.

Subroutines AZSTEP and ELSTEP compute the step functions. This is accomplished by finding the remainder when THYME-AZ(EL) TIME is divided by AZ(EL)PERIOD. If this is less than 777_8 , CONTBL(+1) is incremented by AZ(EL)HEIGHT.

Subroutines AZIMPULSE and ELIMPULSE operate similarly; however, both THYME-AZ(EL)TIME and THYME-AZ(EL)TIME - AZ(EL)DURAT are computed and divided by AZ(EL)PERIOD. If the former remainder is sufficiently small, CONTBL(+1) is incremented by AZ(EL)HEIGHT. If the latter is small, CONTBL(+1) is decremented.

Subroutines AZSINE and ELSINE perform a table look-up operation to simulate the sine without actual computation with the Hastings approximation. The product (AZ(EL)OMEGA*THYME) is calculated, modulo 1 at B21. The high order bits in B1 are used to address SINTBL, while the low order 11 bits are used to interpolate between successive table entries. The result is multiplied by AZ(EL)AMPLITUD and added to AZ(EL)ST, in the A-register.

Subroutines AZRANDOM and ELRANDOM provide for pointing the antenna in a fixed direction. They are referenced whenever the driving specifications AZNOT and ELNOT have been entered.

Subroutine PRINTER effectively converts the azimuth and elevation commands, responses, and errors to decimal or octal and causes them to be printed on-line. The conversion of a line of data containing 7 quantities (decimal) or 9 quantities (octal mode) is multiplexed with the main pointing calculations. The list of JPTABLE specifies the order of execution of the various operations for decimal mode printing. Each time PRINTER is entered, control passes to the next subroutine in the list. GETNUMS picks up the current values of the parameters to be printed and stores them in FIELDS. FDVAR is used to transmit information from the decimal and octal conversion subroutines. The fielddata line to be printed is assembled in PRBUFFER.

Each section named ---CON (example, TIMECON) converts the current value of the integer part of the specified variable to decimal fielddata. Each section named ---CONB (example, TIMECONB) performs the binary-to-decimal conversion to four decimal places for the fractional part of the same variable. The result is, in each case, stored in the appropriate area of PRBUFFER. RUNPRINTER causes the contents of PRBUFFER and STOPMARK to be transmitted to the on-line printer control system. It also terminates the multiplex routine PRINTER by clearing the pointer in PRINTINDIC.

PRCONV1 makes all numbers received through location NUMBER positive, splits them into integer and fractional parts, and calls INTEGERCON, which converts the integer part to a signed three-digit fielddata-decimal integer terminated by a decimal point. FRACTCON converts the fractional part stored in FRACTION.

DRIVINIT sets up interrupt locations for the azimuth and elevation output buffers. DRIVEREAL transmits data to the azimuth and elevation interface systems.

The following table gives the storage locations, binary scale factors, and units for various quantities used frequently in the testing program.

<u>Quantity</u>	<u>Location</u>
Azimuth bias, degrees, B18	AZST
Elevation bias, degrees, B18	ELST
Azimuth, degrees, B18	CONTRL
Elevation, degrees, B18	CONTRL+1
Azimuth, revolutions, B19 (command number system)	AZIMUTH
Elevation, revolutions, B19 (command number system)	ELEVATION
Azimuth encoder bit pattern (command number system)	AZOUT
Elevation encoder bit pattern (command number system)	ELOUT
Relative real time, seconds, B18	THYME

ENCODEREAL reads the azimuth and elevation encoders from the interface equipment into locations AZOUT and ELOUT, performing a small calculation to correct for angles in the overlap zones in azimuth. Subroutine DRIVFIX answers interrupts associated with the azimuth and elevation channels. Subroutine TYPEIN answers interrupts associated with the console keyboard and performs certain elementary operations. As an example, if O or D is typed, it transfers control to FIXOCTPRNT or FIXDECPNT, respectively, which set the printing mode to octal or decimal, as indicated. It performs a similar function with respect to the characters S and P and the locations STOPRINT and GPRINT.

Subroutine RUNNY is a substitute routine for RUNPRINTER in the sense that it terminates the print conversion computation without printing a line. JPTABLEOCT performs the same function in octal printing as does JPTABLE in decimal printing. Each routine named ---OCT calls CONOCT to convert the prefixed variable to fielddata octal (ten characters). As an example, AZDIFOCT converts the error in azimuth to octal for printing.

Since the fields for octal and decimal printing do not precisely coincide, BUFKLEER ensures that extraneous characters are not carried over from one format to the other if format is changed in mid-run.

Addition of Drive Function Subroutines to the Testing Program

A drive function subroutine may be easily added to the program by preparing it in the proper format and by making a few entries in some tables.

The call name (for console type-in) for the subroutine should be entered in fielddata in FUNCTBL. The length of the argument list and the entry address must be entered in FUNADDTBL.

Each subroutine must be prefaced with a table of the addresses and binary points of its input arguments (excluding the time variable). The binary point is placed in the upper half-word and the variable address in the lower. The first argument typed in will be placed in the last specified address, etc., so that the variable addresses are listed in the table in the reverse order from the typed-in line.

B. Program II - IBM 7094 Print Program

This program converts the 490 output tape to a BCD tape that will print on the 1401. The number of files to be processed from input tape A6 is read from A2 and a DO-LOOP is initialized for this number of iterations.

For each file to be printed, the file label is read from A7 and written in BCD mode on A6. The editing factor, N, is read from A2. From this point the program reads in 490 records of 500 36-bit words, converts them and writes them out until an end-of-file is encountered on A6, whereupon the output file on A7 is terminated and the index of the major DO incremented (statement 101).

If an end-of-file is not encountered by subroutine READER in reading A6, IOF will be zero and the program will reverse the order of the input array, storing the reversed array in BUFFER. The entire array is converted to floating point by subroutine FLOTTER, and the various terms in the array are scaled by the appropriate factors (.004 for time, .000686645507 for angles). The errors in azimuth and elevation are computed and stored in DIFFER. Finally, every Nth point is written out on A7 in an appropriate format for 1401 printing.

C. Program III - IBM 7094 Plot Program

This program converts the 490 output tape to a BCD tape suitable for driving the Calcomp plotter to produce graphical output in accordance with input specifications. First, the program requests mounting of an input tape on A7 and pauses. When restored, it reads the number of graphs to be plotted from A2, initializes the Calcomp subroutine, PLOTS, and begins a DO-LOOP for the number of frames of three graphs each to be plotted.

For each graph to be plotted, A7 is rewound. The relevant file label is read from A2, along with the editing parameters. Subroutine READER is called to read the 490 output tape (A7), placing a file label in BUFXIN. The order of the words is reversed as they are transferred to BUFRIN. The file label from A7 is compared with the desired label from A2. If they do not match, A7 is advanced one file by FILSPA and the process repeated.

When the relevant file has been located in this manner, control passes to statement 24. The program section from 24 to 211 is identical to the conversion section of the program CONVERT described above. After a record has been converted, the time fields are scanned to find one greater than TIML. When this is found, the appropriate line of data is transferred to a plot buffer, and TIML is advanced by SPACE. The process continues until the input record is exhausted, then another is read (statement 240). Eventually, TIML exceeds TIMU, and the remainder of the file is spaced over.

Since the Calcomp scaling routine requires an array of non-identical entries, the plot buffers are checked for this before calling SCALE. Those arrays which are scalable and plotable are processed in accordance with indicator IUJ. After the lines of data have been plotted, AXIS and XAXIS are called to draw in the relevant axes. Finally, the label is plotted by SYMBL4, and the graph origin is reset for the next plot.

When three graphs have been drawn, the paper is advanced three inches beyond the end of the longest graph and the pen is reset to the right-hand margin. After all the graphs specified by the input deck have been plotted, the output tapes are rewound and a notice to dismount is printed on-line.

Prior to the final exit, the program pauses (HPR77777).

490 PROGRAM

```

      ***** SPUPT OUTPUT NO. 110 *****

```

ANTENATEST LDMASSEY#24JUN1964

NO.	OF INSTRUCTIONS	
11514		

000000 THRU 01202

01210 THRU 01222

01230 THRU 01242

01244 THRU 01245

—

01311 THRU 01312

01315	THRU	01320
01315	THRU	01320

01325	THRU	01335
01325	THRU	01335

02465 THRU 02465

03615	THRU	03616
03615	THRU	03616

03620	THRU	03620
03423	THRU	03423

03623	THRU	03623
03624	THRU	03626

03626 THRU 03626

03431 11811 03631

03631	THRU	03631
03634	THRU	03634

03634	THRU	03634
03637	THRU	03637

03637	THRU	03637
03640	THRU	03642

03642	THRU	03642
03645	THRU	03645

03643	THRU	03643
03650	THRU	03650

03650 THRU 03650
03653 THRU 03653

03656	THRU	03656
-------	------	-------

1000

03661 THRU 03661

03664 THRU 03664

03667 THRU 03667

03672 THRU 03672

SPIRIT OUTPUT NO. 110

ANTENATEST
LDMASSEY#24JUN1964

CARDS	LI ID LABEL	TA STATEMENT	LOC	F JKB Y	NOTES

***** ANTENATEST PROGRAM LDMASSEY#24 JUN 1964

00001 ANTENTRY
 TYPE\$ \$CR\$ \$LF\$ THIS IS THE ANTENN00000 61000 00011
 A TESTING PROGRAM.

000001	04030	33113
000002	16300	51630
000003	05311	51205
000004	06233	11223
000005	23060	53112
000006	30311	62314

00007	05252	72414
00010	27062	27500
00011	64120	00142

00002	MAIN	CL	B1
00003	SINECALC	ENT	A*B1
00004		RSH	AQ#20D

00005	RJP	SINEFUNCS	00017	65000	04275
00006	STR	Q*W(SINTBL+B1)	00020	14031	04513
00007	BSK	B1*2048D	00021	71100	04000
00010	JP	SINECALC	00022	61000	00015
00011	TYPE	\$CROSSLFSDO YOU WISH TO HAVE	0000023	61000	00037

00024	04031	12405
00025	36243	20534

000026	16301	50531
000027	24051	50633
000030	12052	43231
000031	25323	10524
000032	23053	11512
000033	05242	34121
000034	16231	20525
000035	27162	33112

00036	27750	40000
00037	64120	00142
00040	00000	00065
00041	00000	00024
00042	61000	00047
00043	04161	30530
00044	24560	51524
00045	34052	41331

00012 TYPE \$CR\$IF \$O: HOW OFTEN \$CR\$

00046	12237	50400
00047	64120	00142
00050	00000	00023
00051	00000	00043
00052	64120	00142
00053	02010	01242
00054	00000	00000
00055	11000	00000
00056	10030	01242
00057	05000	00002
00060	07000	00001
00061	15520	01242
00062	61000	00137
00063	11000	00000
00064	05000	00025
00065	07000	00006
00066	10030	01243
00067	07000	00014
00070	06000	00014
00071	20000	07556
00072	15030	04144
00073	16030	04147
00074	65000	04017
00075	11030	04150
00076	21000	00001
00077	15010	01242
00100	21700	00030
00101	61000	00140
00102	61000	00120
00103	04221	62316
00104	22322	20516
00105	23311	22733
00106	06210	51630
00107	05626	50510
00110	36102	11230
00111	05251	22705
00112	25271	62331
00113	12110	52116
00114	23125	60527
00115	12313	62512
00116	22123	03006
00117	14127	50400
00120	64120	00142
00121	00000	00100
00122	00000	00103
00123	61000	00052
00124	12000	00000
00042	JP	REACCEPT
00043	NO-OP	

•	00106	ACCEPT	180D*INPUTBUFER	00204	04313	62512
•				00205	05311	23031
•				00206	05250	62706
•				00207	22123	11227
•				00210	30750	40000
•				00211	64120	00142
•				00212	00000	00027
•				00213	00000	00204
•				00214	64120	00142
•				00215	02264	01245
•	00107	ENT	A*W(TYPEIN)	00216	00000	00000
•	00110	STR	A*W(42)	00217	11030	11306
•	00111	IN	C2*W(TINBUF)*MONITOR	00220	15030	00042
•	00112	CL	A*	00221	75130	11333
•	00113	ENT	Q*W(INPUTBUFER)	00222	11000	00000
•				00223	10030	01245
•	00114	LSH	AQ*12D	00224	07000	00014
•	00115	SUB	A*7575*ANOT	00225	21500	07575
•	00116	JP	NOMORE	00226	61000	01022
•	00117	CL	A*	00227	11000	00000
•	00120	CL	B1*	00230	12100	00000
•	00121	CL	B3*	00231	12300	00000
•	00122	CL	B4*	00232	12400	00000
•	00123	CL	B6	00233	12600	00000
•	00124	ENT	Q*W(INPUTBUFER+B1)	00234	10031	01245
•	00125	CL	W(TEMBX+B3)	00235	16033	01312
•	00126	CL	B2*	00236	12200	00000
•	00127	LSH	AQ*6	00237	07000	00006
•	00130	STR	A*W(TEMAX)	00240	15030	01315
•	00131	SUB	A*77*ANOT	00241	21500	00077
•	00132	JP	CODEDELETE	00242	61000	00370
•	00133	ENT	A*W(TEMAX)	00243	11030	01315
•	00134	SUB	A*57*ANOT	00244	21500	00057
•	00135	JP	VIRGULE	00245	61000	00375
•	00136	ENT	A*W(TEMAX)	00246	11030	01315
•	00137	SUB	A*56*ANOT	00247	21500	00056
•	00140	JP	COMMA	00250	61000	00336
•	00141	ENT	A*W(TEMBX+B3)	00251	11033	01312
•	00142	STR	Q*W(TEMCX)	00252	14030	01316
•	00143	ENT	Q*W(TEMAX)	00253	10030	01315
•	00144	LSH	Q*24D	00254	05000	00030
•	00145	LSH	AQ*6	00255	07000	00006
•	00146	STR	A*W(TEMBX+B3)	00256	15033	01312
•	00147	BSK	B6*4	00257	71600	00004
•	00150	JP	CODEDELETE	00260	61000	00370
•	00151	BSK	B3*2	00261	71300	00002
•	00152	JP	AGAINXY	00262	61000	00367
•	00153	JP	AGAINY	00263	61000	00305

•	00174	LSH	Q*24D	00342	05000	00030
•	00175	LSH	AQ*6	00343	07000	00006
•	00176	STR	A*W(TEMBX+B3)	00344	15033	01312
•	00177	ENT	A*4	00345	11000	00004
•	00200	STR	B6*L(TEMAX)	00346	16010	01315
•	00201	SUB	A*L(TEMAX)	00347	21010	01315
•	00202	ENT	Q*4	00350	10070	00000
•	00203	MUL	6	00351	22000	00006
•	00204	STR	Q*L(TEMAX)	00352	14010	01315
•	00205	ENT	Q*W(TEMBX+B3)	00353	10033	01312
•	00206	LSH	Q*L(TEMAX)	00354	05010	01315
•	00207	STR	Q*W(TEMBX+B3)	00355	14033	01312
•	00210	ENT	B5*L(TABLE-1+B4)	00356	12514	01156
•	00211	ENT	A*W(TEMBX)	00357	11030	01312
•	00212	STR	A*W(B5)	00360	15035	00000
•	00213	ENT	A*W(TEMBX+1)	00361	11030	01313
•	00214	STR	A*W(1+B5)	00362	15035	00001
•	00215	ENT	A*W(TEMBX+2)	00363	11030	01314
•	00216	STR	A*W(2+B5)	00364	15035	00002
•	00217	CL	B3	00365	12300	00000
•	00220	CL	B6	00366	12600	00000
•	00221	CL	W(TEMBX+B3)	00367	16033	01312
•	00222	BSK	B2*4	00370	71200	00004
•	00223	JP	AGAINX	00371	61000	00302
•	00224	BSK	B1*36D	00372	71100	00044
•	00225	JP	AGAINZ	00373	61000	00332
•	00226	JP	LINERROR	00374	61000	00264
•	00227	STR	B4*L(NFIELDS)	00375	16410	01317
•	00230	CL	B1*	00376	12100	00000
•	00231	ENT	B2*L(TABLE+B1)	00377	12211	01157
•	00232	ENT	B3*U(TABLE+B1)	00400	12321	01157
•	00233	ENT	A*W(B2)	00401	11032	00000
•	00234	STR	A*W(NUMBER)	00402	15030	04144
•	00235	ENT	A*W(1+B2)	00403	11032	00001
•	00236	STR	A*W(NUMBER+1)	00404	15030	04145
•	00237	ENT	A*W(2+B2)	00405	11032	00002
•	00240	STR	A*W(NUMBER+2)	00406	15030	04146
•	00241	STR	B3*L(BINPNT)	00407	16310	04147
•	00242	ENT	Q*W(NUMBER)	00410	10030	04144
•	00243	CL	A	00411	11000	00000
•	00244	LSH	AQ*6	00412	07000	00006
•	00245	SUB	A*56*ANOT	00413	21500	00056
•	00246	JP	SAMEVALUE	00414	61000	00420
•	00247	RJP	DECON	00415	65000	04017
•	00250	ENT	A*W(ACCUM)	00416	11030	04150
•	00251	STR	A*W(CONTBL+B1)	00417	15031	01320
•	00252	BSK	B1*4	00420	71100	00004
•	00253	JP	CYCLE	00421	61000	00377

00154 LINERROR	TYPET	SCR\$SLF\$INPUT LINE TOO LONG.	00264	61000	00276
		THIS LINE DELETED.SCR\$			
			00265	04031	62325
			00266	32310	52116
			00267	23120	53124
			00270	24052	12423
			00271	14750	50531
			00272	15163	00521
			00273	16231	20511
			00274	12211	23112
			00275	11750	40000
			00276	64120	00142
			00277	00000	00053
			00300	00000	00265
			00301	61000	00203
			00302	10030	01316
			00303	11000	00000
			00304	61000	00237
			00305	61000	00316
			00306	04030	62305
			00307	16232	53231
			00310	05131	61221
			00311	11051	23510
			00312	12121	13005
			00313	61650	51015
			00314	06270	61031
			00315	12273	07504
			00316	64120	00142
			00317	00000	00050
			00320	00000	00306
			00321	61000	00326
			00322	31151	63005
			00323	21162	31205
			00324	11122	11231
			00325	12117	50400
			00326	64120	00142
			00327	00000	00023
			00330	00000	00322
			00331	61000	00203
			00332	11000	00000
			00333	10031	01245
			00334	12200	00000
			00335	61000	00237
			00336	71400	00035
			00337	11033	01312
			00340	14030	01316
			00341	10030	01315
			00342	10030	01315
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			00471	10030	01315
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			00509	10030	01315
			00510	10030	01315
			00511	10030	01315
			00512	10030	01315
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			00514	10030	01315
			00515	10030	01315
			00516	10030	01315
			00517	10030	01315
			00518	10030	01315

•	00311	ENT	B6*L(TABLE+7*B5)	00501	12615	01166
•	00312	ENT	A*W(B6)	00502	11036	00000
•	00313	STR	A*W(NUMBER)	00503	15030	04144
•	00314	ENT	A*W(1+B6)	00504	11036	00001
•	00315	STR	A*W(NUMBER+1)	00505	15030	04145
•	00316	ENT	A*W(2+B6)	00506	11036	00002
•	00317	STR	A*W(NUMBER+2)	00507	15030	04146
•	00320	ENT	A*W(NUMBER)	00510	11030	04144
•	00321	SUB	A*5600000000*ANOT	00511	21530	11504
•	00322	JP	NEXTX-1	00512	61000	00516
•	00323	RJP	DECON	00513	65000	04017
•	00324	ENT	A*W(ACCUM)	00514	11030	04150
•	00325	STR	A*W(B4)	00515	15034	00000
•	00326	BJP	B2*NEXTX	00516	72200	00517
•	00327	BSK	B5*100	00517	71500	00100
•	00330	JP	NEXTX+2	00520	61000	00521
•	00331	BJP	B3*ARGLOOP	00521	72300	00476
•	00332	BSK	B1*1	00522	71100	00001
•	00333	JP	BARGLOOP	00523	61000	00472
•	00334	ENT	A*U(FUNLOC+1)	00524	11020	03617
•	00335	ADD	A*U(FUNLOC)	00525	20020	03616
•	00336	SUB	A*L(NFIELDS)*ANOT	00526	21510	01317
•	00337	JP	ZKFDCNT	00527	61000	00547
•	00340	TYPEY	SCR\$LF\$INCORRECT NUMBER OF F100530	61000	00543	

ELDS. THIS LINE DELETED.SCRs

00531	04031	62310
00532	24272	71210
00533	31052	33222
00534	07122	70524
00535	13051	31612
00536	21113	07505
00537	05311	51630

00540	05211	62312
00541	05111	22112
00542	31121	17504
00543	64120	00142
00544	00000	00062
00545	00000	00531
00546	61000	00203
00547	61100	00551

JP	CONINETC
JP	FIDGE*KEY1

•	00341	JP	CONINETC	
•	00342	ZKFDCNT	JP	FIDGE*KEY1

00550	61000	11210
00551	16030	00017
00552	11030	01145
00553	15030	00036
00554	11030	01320
00555	10030	01321
00556	15030	03711
00557	14030	03712

JP	DRIVINIT
CL	W(17)
ENT	A*W(DRIVE2)
STR	A*W(36)
ENT	A*W(CONTBL)
ENT	Q*W(CONTBL+1)
STR	A*W(AZST)
STR	Q*W(ELST)

•	00343	JP	DRIVINIT	
•	00344	FIDGE	CL	W(17)
•	00345	ENT	A*W(DRIVE2)	
•	00346	STR	A*W(36)	
•	00347	INITRET	ENT	A*W(CONTBL)
•	00350	ENT	Q*W(CONTBL+1)	
•	00351	STR	A*W(AZST)	
•	00352	STR	Q*W(ELST)	

•	00353	RJP	DEGCON	00560	65000	01114
•	00354	STR	A*W(AZIMUTH)	00561	15030	01331
•	00355	STR	Q*W(ELEVATION)	00562	14030	01332
•	00356	ENT	Q*W(CONTBL+2)	00563	10030	01322
•	00357	MUL	250D	00564	22000	00372
•	00360	SUB	Q*1	00565	27000	00001
•	00361	STR	Q*W(NWAIT)	00566	14030	01325
•	00362	ENT	Q*W(CONTBL+3)	00567	10030	01323
•	00363	MUL	250D	00570	22000	00372
•	00364	SUB	Q*1	00571	27000	00001
•	00365	STR	Q*W(NRUN)	00572	14030	01326
•	00366	ENT	Q*W(CONTBL+4)	00573	10030	01324
•	00367	SUB	Q*1	00574	27000	00001
•	00370	STR	Q*W(FREQOUT)	00575	14030	01311
•	00371	ENT	B1*3750D	00576	12100	07246
•	00372	ENT	A*77774	00577	11000	77774
•	00373	STR	A*U(17)	00600	15020	00017
•	00374	RJP	DRIVE*KEY1	00601	65100	01135
•	00375	JP	FIDGET*KEY1	00602	61100	00604
•	00376	RJP	DRIVEREAL	00603	65000	11224
•	00377	BJP	B1*FIRSTPOSIT	00604	72100	00601
•	00400	ENT	B1*L(NRUN)	00605	12110	01326
•	00401	ENT	B4*U(NRUN)	00606	12420	01326
•	00402	ENT	B2*L(FREQOUT)	00607	12210	01311
•	00403	ENT	B5*L(NWAIT)	00610	12510	01325
•	00404	CL	W(FIRST)	00611	16030	04134
•	00405	CL	B6*	00612	12600	00000
•	00406	ENT	A*W(NRUN)	00613	11030	01326
•	00407	ADD	A*L(NWAIT)	00614	20010	01325
•	00410	SUB	A*B1	00615	21001	00000
•	00411	CL	Q	00616	10000	00000
•	00412	RSH	AQ*15D	00617	03000	00017
•	00413	SUB	A*B4	00620	21004	00000
•	00414	LSH	AQ*3	00621	07000	00003
•	00415	DIV	250D	00622	23000	00372
•	00416	STR	Q*W(THYME)	00623	14030	03713
•	00417	RJP	L(FUNLOC+1)	00624	65010	03617
•	00420	STR	A*W(CONTBL+1)	00625	15030	01321
•	00421	RJP	L(FUNLOC)	00626	65010	03616
•	00422	STR	A*W(CONTBL)	00627	15030	01320
•	00423	ENT	Q*W(CONTBL+1)	00630	10030	01321
•	00424	RJP	DEGCON	00631	65000	01114
•	00425	STR	A*W(AZIMUTH)	00632	15030	01331
•	00426	STR	Q*W(ELEVATION)	00633	14030	01332
•	00427	RJP	DRIVE*KEY1	00634	65100	01135
•	00430	JP	FIDGETTE*KEY1	00635	61100	00637
•	00431	RJP	DRIVEREAL	00636	65000	11224
•	00432	BJP	B5*POINTGEN	00637	72500	00613

•	00433		BJP	B2*BUFDONE	00640	72200	00642
•	00434		JP	WRITEBUF	00641	61000	00706
•	00435	BUFDONE	ENT	A*(ZXNLINEIND)*ANOT	00642	11520	01242
•	00436		JP	PRINTRET	00643	61000	00650
•	00437		BJP	B3*PRINTRETEX	00644	72300	00646
•	00440		JP	WRITELINE	00645	61000	00703
•	00441	PRINTRETEX	ENT	A*(PRINTINDIC)*AZERO	00646	11430	01156
•	00442		RJP	PRINTER	00647	65000	10602
•	00443	PRINTRET	BJP	B1*POINTGEN	00650	72100	00613
•	00444		ENT	B1*77777	00651	12100	77777
•	00445		BJP	B4*POINTGEN	00652	72400	00613
•	00446		ENT	A*(INTCLKTEST)	00653	11030	00140
•	00447		STR	A*(36)	00654	15030	00036
•	00450		TERM	C2*INPUT	00655	66100	00000
•	00451		STR	B6*(TEMAX)	00656	16630	01315
•	00452		ENT	A*6000	00657	11000	01130
•	00453		RPL	A-Y*(TEMAX)	00660	25030	01315
•	00454		ENT	A*(FIRST)*ANOT	00661	11530	04134
•	00455		JP	CLRBUFA	00662	61000	00676
•	00456		CLEAR	W(TEMAX)*BUFB+B6	00663	70130	01315
•	00457	ZZZZ	JP	ZZZZ*C15*ACTIVEOUT	00664	16036	02465
•	00460		RJP	TAPEWRITE	00665	63640	00665
•	00461		ENT	A*(AZST)	00666	65000	01075
•	00462		ENT	Q*(ELST)	00667	11030	03711
•	00463		STR	A*(CONTRL)	00670	10030	03712
•	00464		STR	Q*(CONTRL+1)	00671	15030	01320
•	00465		ENT	A*(INTCLKTEST)	00672	14030	01321
•	00466		STR	A*(36)	00673	11030	00140
•	00467		JP	PROGRAM	00674	15030	00036
•	00470	CLRBUFA	CLEAR	W(TEMAX)*BUFA+B6	00675	61000	00124
•	00471	ZXYZ	JP	ZXYZ*C15*ACTIVEOUT	00676	70130	01315
•	00472		RJP	TAPEWRITE	00677	16036	01335
•	00473		JP	PROGRAM	00700	63640	00700
•	00474	WRITELINE	ENT	B3*(ZXNLINEIND)	00701	65000	01075
•	00475		RJP	PRINTER	00702	61000	00124
•	00476		JP	PRINTRET	00703	12310	01242
•	00477	WRITEBUF	ENT	B2*(FREQUOT)	00704	65000	10602
•	00500		RJP	ENCODE	00705	61000	00650
•	00501		ENT	A*(NRUN)	00706	12210	01311
•	00502		ADD	A*(NWAIT)	00707	65000	01146
•	00503		STR	B1*(TEMAX)	00710	11030	01326
•	00504		STR	B4*(TEMAX)	00711	20010	01325
•	00505		SUB	A*(TEMAX)	00712	16110	01315
•	00506		STR	A*(TIME)	00713	16420	01315
•	00507		ENT	A*(FIRST)*ANOT	00714	21030	01315
•	00510		JP	USEBUFA	00715	15030	01330
•					00716	11530	04134
•					00717	61000	00762

00511	CL	Q*	00720	10000	00000
00512	ENT	A*W(TIME)	00721	11030	01330
00513	RSH	AQ*6	00722	03000	00006
00514	STR	A*W(BUFB+B6)	00723	15036	02465
00515	CL	A*	00724	11000	00000
00516	LSH	AQ*12D	00725	07000	00014
00517	ENT	Q*W(AZIMUTH)*QPOS	00726	10230	01331
00520	SUB	Q*1	00727	27000	00001
00521	LSH	AQ*18D	00730	07000	00022
00522	STR	A*W(BUFB+1+B6)	00731	15036	02466
00523	CL	A*	00732	11000	00000
00524	LSH	AQ*18D	00733	07000	00022
00525	ENT	Q*W(AZOUT)	00734	10030	01333
00526	LSH	AQ*12D	00735	07000	00014
00527	STR	A*W(BUFB+2+B6)	00736	15036	02467
00530	CL	A*	00737	11000	00000
00531	LSH	AQ*24D	00740	07000	00030
00532	ENT	Q*W(ELEVATION)*QPOS	00741	10230	01332
00533	SUB	Q*1	00742	27000	00001
00534	LSH	AQ*6	00743	07000	00006
00535	STR	A*W(BUFB+3+B6)	00744	15036	02470
00536	STR	A*W(BUFB+4+B6)	00745	14036	02471
00537	ENT	Q*W(ELOUT)	00746	10030	01334
00540	STR	Q*W(BUFB+5+B6)	00747	14036	02472
00541	BSK	B6*594D	00750	71600	01122
00542	JP	UNFULLB	00751	61000	00755
00543	RJP	TAPEWRITE	00752	65000	01075
00544	CL	W(FIRST)	00753	16030	04134
00545	JP	BUFDONE	00754	61000	00642
00546	STR	B6*L(TEMAX)	00755	16610	01315
00547	ENT	Q*5	00756	10000	00005
00550	RPL	Y+Q*L(TEMAX)	00757	34010	01315
00551	ENT	B6*L(TEMAX)	00760	12610	01315
00552	JP	BUFDONE	00761	61000	00642
00553	CL	Q*	00762	10000	00000
00554	ENT	A*W(TIME)	00763	11030	01330
00555	RSH	AQ*6	00764	03000	00006
00556	STR	A*W(BUFA+B6)	00765	15036	01335
00557	CL	A*	00766	11000	00000
00560	LSH	AQ*12D	00767	07000	00014
00561	ENT	Q*W(AZIMUTH)	00770	10030	01331
00562	LSH	AQ*18D	00771	07000	00022
00563	STR	A*W(BUFA+1+B6)	00772	15036	01336
00564	CL	A*	00773	11000	00000
00565	LSH	AQ*18D	00774	07000	00022
00566	ENT	Q*W(AZOUT)	00775	10030	01333
00567	LSH	AQ*12D	00776	07000	00014
00570	STR	A*W(BUFA+2+B6)	00777	15036	01337

Address	Label	Value	ST ENCODE
00677	ENT A*(DRIVE2)	01136	11030 01145
00700	STR A*(36)	01137	15030 00036
00701	JP DRIVE+1	01140	61000 01136
00702	ENT A*77774	01141	11000 77774
00703	STR A*(17)	01142	15020 00017
00704	RIL	01143	60000 00000
00705	JP L(DRIVE)	01144	61010 01135
00706	JP DRIVE1	01145	61000 01141
00707	RESERVE 1	01146	00000 00000
00710	JP ENCODEX*KEY1	01147	61100 01151
00711	JP ENCODEREAL	01150	61000 11243
00712	ENT A*(AZIMUTH)	01151	11030 01331
00713	ENT G*(ELEVATION)	01152	10030 01332
00714	STR A*(AZOUT)	01153	15030 01333
00715	STR G*(ELOUT)	01154	14030 01334
00716	JP L(ENCODE)	01155	61010 01146
00717	BANG		
00720	PRINTINDIC		
00721	TABLE		
00722	U-TAG BANG*THETA	01156	00000 00000
00723	U-TAG BANG*PHIFD	01160	00022 03620
00724	U-TAG ZERO*TWAITFD	01161	00000 03626
00725	U-TAG ZERO*TRUNFD	01162	00000 03631
00726	U-TAG ZERO*IWRITEFD	01163	00000 03634
00727	U-TAG ZERO*FAZI	01164	00000 03637
00728	U-TAG ZERO*FELE	01165	00000 03642
00730	U-TAG ZERO*ARG1	01166	00000 03645
00731	U-TAG ZERO*ARG2	01167	00000 03650
00732	U-TAG ZERO*ARG3	01170	00000 03653
00733	U-TAG ZERO*ARG4	01171	00000 03656
00734	U-TAG ZERO*ARG5	01172	00000 03661
00735	U-TAG ZERO*ARG6	01173	00000 03664
00736	U-TAG ZERO*ARG7	01174	00000 03667
00737	U-TAG ZERO*ARG8	01175	00000 03672
00740	U-TAG ZERO*ARG9	01176	00000 03675
00741	U-TAG ZERO*ARG10	01177	00000 03700
00742	U-TAG ZERO*ARG11	01200	00000 03703
00743	U-TAG ZERO*ARG12	01201	00000 03706
00744	FUNCIBL	01202	00000 00000
00745	FD 1*ELNOT	01210	12212 32431
00746	FD 1*AZNOT	01211	06372 32431
00747	FD 1*ELPOL	01212	12212 52421
00750	FD 1*AZPOL	01213	06372 52421
00751	FD 1*EL SIN	01214	12213 01623
00752	FD 1*AZ SIN	01215	06373 01623
00753	FD 1*EL STE	01216	12213 03112
00754	FD 1*AZ STE	01217	06373 03112
00755	FD 1*EL IMP	01220	12211 62225
00756	FD 1*AZ IMP	01221	06371 62225

•	00757	FUNADDTBL	RESERVE	6		01222	00000	00000
•	00760		U-TAG	NARANDOM#ELRANDOM		01230	00001	10573
•	00761		U-TAG	NARANDOM#AZRANDOM		01231	00001	10577
•	00762		U-TAG	NAPOLY#ELPOLY		01232	00006	03727
•	00763		U-TAG	NAPOLY#AZPOLY		01233	00006	03757
•	00764		U-TAG	NASINE#ELSINE		01234	00002	10545
•	00765		U-TAG	NASINE#AZSINE		01235	00002	10516
•	00766		U-TAG	NASTEP#ELSTEP		01236	00003	04403
•	00767		U-TAG	NASTEP#AZSTEP		01237	00003	04364
•	00770		U-TAG	NAIMPULSE#ELIMPULSE		01240	00004	04463
•	00771		U-TAG	NAIMPULSE#AZIMPULSE		01241	00004	04431
•	00772	ZERO	EQUALS	00000				
•	00773	NARANDOM	EQUALS	1				
•	00774	NAPOLY	EQUALS	6				
•	00775	NASINE	EQUALS	2				
•	00776	NASTEP	EQUALS	3				
•	00777	NAIMPULSE	EQUALS	4				
•	01000	ZXNLINENO	RESERVE	2		01242	00000	00000
•	01001	CLKTEST	RESERVE	1		01244	00000	00000
•	01002	INPUTBUFFER	RESERVE	360		01245	00000	00000
•	01003	FREQOUT	RESERVE	1		01311	00000	00000
•	01004	TEMBX	RESERVE	3		01312	00000	00000
•	01005	TEMAX	RESERVE	1		01315	00000	00000
•	01006	TENCX	RESERVE	1		01316	00000	00000
•	01007	NFIELDS	RESERVE	1		01317	00000	00000
•	01010	CONTRL	RESERVE	5		01320	00000	00000
•	01011	NWAIT	RESERVE	1		01325	00000	00000
•	01012	NRUN	RESERVE	1		01326	00000	00000
•	01013	ANGLESAVE	RESERVE	1		01327	00000	00000
•	01014	TIME	RESERVE	1		01330	00000	00000
•	01015	AZIMUTH	RESERVE	1		01331	00000	00000
•	01016	ELEVATION	RESERVE	1		01332	00000	00000
•	01017	AZOUT	RESERVE	1		01333	00000	00000
•	01020	ELOUT	RESERVE	1		01334	00000	00000
•	01021	BUFA	RESERVE	6000		01335	00000	00000
•	01022	BUFB	RESERVE	6000		02465	00000	00009
•	01023	CONTIND	RESERVE	1		03615	00000	00000
•	01024	FUNLOC	RESERVE	2		03616	00000	00000
•	01025	THETAFO	RESERVE	3		03620	00000	00000
•	01026	PHIFD	RESERVE	3		03623	00000	00000
•	01027	TWAITFD	RESERVE	3		03626	00000	00000
•	01030	TRUNFD	RESERVE	3		03631	00000	00000
•	01031	IWRITEFD	RESERVE	3		03634	00000	00000
•	01032	FAZI	RESERVE	3		03637	00000	00000
•	01033	FELE	RESERVE	3		03642	00000	00000
•	01034	ARG1	RESERVE	3		03645	00000	00000
•	01035	ARG2	RESERVE	3		03650	00000	00000
•	01036	ARG3	RESERVE	3		03653	00000	00000

•	01037	ARG4	RESERVE	3	03656	00000	00000
•	01040	ARG5	RESERVE	3	03661	00000	00000
•	01041	ARG6	RESERVE	3	03664	00000	00000
•	01042	ARG7	RESERVE	3	03667	00000	00000
•	01043	ARG8	RESERVE	3	03672	00000	00000
•	01044	ARG9	RESERVE	3	03675	00000	00000
•	01045	ARG10	RESERVE	3	03700	00000	00000
•	01046	ARG11	RESERVE	3	03703	00000	00000
•	01047	ARG12	RESERVE	3	03706	00000	00000
•	01050	AZST	RESERVE	1	03711	00000	00000
•	01051	ELST	RESERVE	1	03712	00000	00000
•	01052	THYME	RESERVE	1	03713	00000	00000
•	01053	THETA	RESERVE	1	03714	00000	00000
•	01054	PHI	RESERVE	1	03715	00000	00000
•	01055	TWAIT	RESERVE	1	03716	00000	00000
•	01056	TRUN	RESERVE	1	03717	00000	00000
•	01057	IWRITE	RESERVE	1	03720	00000	00000
•	01060		U-TAG	AX+13*18D	03721	04015	00022
•	01061		U-TAG	AX+12*18D	03722	04014	00022
•	01062		U-TAG	AX+11*18D	03723	04013	00022
•	01063		U-TAG	AX+10*18D	03724	04012	00022
•	01064		U-TAG	AX+7*18D	03725	04011	00022
•	01065		U-TAG	AX+6*18D	03726	04010	00022
•	01066	ELPOLY	RESERVE	1	03727	00000	00000
•	01067		STR	B1*L(POLYB)	03730	16110	04016
•	01070		CL	A	03731	11000	00000
•	01071		ENT	Q*W(THYME)	03732	10030	03713
•	01072		LSH	AQ*4	03733	07000	00004
•	01073		DIV	10D	03734	23000	00012
•	01074		STR	Q*W(THYMEX)	03735	14030	04001
•	01075		ENT	B1*4	03736	12100	00004
•	01076		ENT	Q*W(AX+13)	03737	10030	04015
•	01077	ELPOLYLOOP	MUL	W(THYMEX)	03740	22030	04001
•	01100		RSH	AQ*22D	03741	03000	00026
•	01101		ADD	Q*W(AX+6+B1)	03742	26031	04010
•	01102		BJP	B1*ELPOLYLOOP	03743	72100	03740
•	01103		STR	Q*W(QSAVE)	03744	14030	04143
•	01104		ENT	A*W(QSAVE)	03745	11030	04143
•	01105		ADD	A*W(ELST)	03746	20030	03712
•	01106		ENT	B1*L(POLYB)	03747	12110	04016
•	01107		JP	L(ELPOLY)	03750	61010	03727
•	01110		U-TAG	AX+5*18D	03751	04007	00022
•	01111		U-TAG	AX+4*18D	03752	04006	00022
•	01112		U-TAG	AX+3*18D	03753	04005	00022
•	01113		U-TAG	AX+2*18D	03754	04004	00022
•	01114		U-TAG	AX+1*18D	03755	04003	00022
•	01115		U-TAG	AX*18D	03756	04002	00022
•	01116	AZPOLY	RESERVE	1	03757	00000	00000

.	01117	STR	B1*(POLY8)	03760	16110	04016
.	01120	CL	A	03761	11000	00000
.	01121	ENT	Q*W(THYME)	03762	10030	03713
.	01122	LSH	AQ*4	03763	07000	00004
.	01123	DIV	10D	03764	23000	00012
.	01124	STR	Q*W(THYME)	03765	14030	04001
.	01125	ENT	B1*4	03766	12100	00004
.	01126	ENT	Q*W(AX+5)	03767	10030	04007
.	01127	ASPOLYLOOP				
.	01130	MUL	W(THYME)	03770	22030	04001
.	01131	RSH	AQ*22D	03771	03000	00026
.	01132	ADD	Q*W(AX+B1)	03772	26031	04002
.	01133	BJP	B1*AZPOLYLOOP	03773	72100	03770
.	01134	STR	Q*W(QSAVE)	03774	14030	04143
.	01135	ENT	A*W(QSAVE)	03775	11030	04143
.	01136	ADD	A*W(AZST)	03776	20030	03711
.	01137	ENT	B1*(POLY8)	03777	12110	04016
.	01137	JP	L(AZPOLY)	04000	61010	03757
.	01140	RESERVE	1	04001	00000	00000
.	01141	RESERVE	12D	04002	00000	00000
.	01142	RESERVE	1	04016	00000	00000
.	01143	RESERVE	1	04017	00000	00000
.	01144	STR	A*W(ASAVE)	04020	15030	04141
.	01145	STR	Q*W(QSAVE)	04021	14030	04143
.	01146	STR	B1*(BSAVE)	04022	16120	04142
.	01147	STR	B2*(BSAVE)	04023	16210	04142
.	01150	CL	W(NDEC)	04024	16030	04151
.	01151	CL	W(DESIGNFLG)	04025	16030	04133
.	01152	CL	W(FIRST)	04026	16030	04134
.	01153	CL	W(ACCUM)	04027	16030	04150
.	01154	CL	B1*	04030	12100	00000
.	01155	CL	A*	04031	11000	00000
.	01156	ENT	Q*W(NUMBER+B1)	04032	10031	04144
.	01157	ENT	B2*4	04033	12200	00004
.	01160	LSH	AQ*6	04034	07000	00006
.	01161	STR	A*W(TEMC)	04035	15030	04137
.	01162	SUB	A*56*ANOT	04036	21500	00056
.	01163	JP	SCALING	04037	61000	04075
.	01164	ENT	A*W(TEMC)	04040	11030	04137
.	01165	SUB	A*41*ANOT	04041	21500	00041
.	01166	JP	AMINUS	04042	61000	04073
.	01167	ENT	A*W(TEMC)	04043	11030	04137
.	01170	SUB	A*42*ANOT	04044	21500	00042
.	01171	JP	DECRET	04045	61000	04064
.	01172	ENT	A*W(TEMC)	04046	11030	04137
.	01173	SUB	A*75*ANOT	04047	21500	00075
.	01174	JP	DECIMAL	04050	61000	04071
.	01175	ENT	A*W(TEMC)	04051	11030	04137
.	01176	STR	Q*W(TEMA)	04052	14030	04135

•	01177	ENT Q*17	04053	10000	00017
•	01200	STR L*W(TEMB)	04054	47030	04136
•	01201	ENT Q*W(ACCUM)	04055	10030	04150
•	01202	MUL 100	04056	22000	00012
•	01203	ADD Q*W(TEMB)	04057	26030	04136
•	01204	STR Q*W(ACCUM)	04060	14030	04150
•	01205	ENT Q*W(TEMA)	04061	10030	04135
•	01206	ENT A*U(DEC SIGNFLG)*AZERO	04062	11420	04133
•	01207	RPL Y+1*W(NDEC)	04063	36030	04151
•	01210	CL A*	04064	11000	00000
•	01211	BJP B2*LOOP8	04065	72200	04034
•	01212	B5K B1*2	04066	71100	00002
•	01213	JP LOOPA	04067	61000	04031
•	01214	JP SCALING	04070	61000	04075
•	01215	RPL Y+1*U(DEC SIGNFLG)	04071	36020	04133
•	01216	JP DECRET	04072	61000	04064
•	01217	RPL Y+1*L(DEC SIGNFLG)	04073	36010	04133
•	01220	JP DECRET	04074	61000	04064
•	01221	RPL Y-1*W(NDEC)*APOS	04075	37630	04151
•	01222	JP NOSCALE	04076	61000	04104
•	01223	ENT Q*100	04077	10000	00012
•	01224	RPT W(NDEC)	04100	70030	04151
•	01225	MUL 100	04101	22000	00012
•	01226	STR Q*W(TENPOWER)	04102	14030	04140
•	01227	JP BINSKALE	04103	61000	04106
•	01230	ENT Q*1	04104	10000	00001
•	01231	STR Q*W(TENPOWER)	04105	14030	04140
•	01232	ENT Q*W(ACCUM)	04106	10030	04150
•	01233	ENT A*U(BINPNT)*AZERO	04107	11420	04147
•	01234	JP BINEG	04110	61000	04115
•	01235	CL A*	04111	11000	00000
•	01236	LSH AQ*L(BINPNT)	04112	07010	04147
•	01237	DIV W(TENPOWER)	04113	23030	04140
•	01240	JP SIGNFIX	04114	61000	04121
•	01241	CL A*	04115	11000	00000
•	01242	DIV W(TENPOWER)	04116	23030	04140
•	01243	CL A*	04117	11000	00000
•	01244	RSH Q*L(BINPNT)	04120	01010	04147
•	01245	STR Q*W(ACCUM)	04121	14030	04150
•	01246	ENT A*L(DEC SIGNFLG)*ANOT	04122	11510	04133
•	01247	JP THRU	04123	61000	04126
•	01250	CL A*	04124	11000	00000
•	01251	RPL A-Y*W(ACCUM)	04125	25030	04150
•	01252	ENT A*W(ASAVE)	04126	11030	04141
•	01253	ENT Q*W(QSAVE)	04127	10030	04143
•	01254	ENT B1*U(BSAVE)	04130	12120	04142
•	01255	ENT B2*L(BSAVE)	04131	12210	04142
•	01256	JP L(DECON)	04132	61010	04017

01257	DESIGNFLG	RESERVE 1	04133	0000	00000
01260	FIRST	RESERVE 1	04134	0000	00000
01261	TEMA	RESERVE 1	04135	0000	00000
01262	TEMB	RESERVE 1	04136	0000	00000
01263	TENC	RESERVE 1	04137	0000	00000
01264	TENPOWER	RESERVE 1	04140	0000	00000
01265	ASAVE	RESERVE 1	04141	0000	00000
01266	BSAVE	RESERVE 1	04142	0000	00000
01267	QSAVE	RESERVE 1	04143	0000	00000
01270	NUMBER	RESERVE 3	04144	0000	00000
01271	BINPNT	RESERVE 1	04147	0000	00000
01272	ACCUM	RESERVE 1	04150	0000	00000
01273	NDEC	RESERVE 1	04151	0000	00000
01274	FIXTC	RESERVE 1	04152	0000	00000
01275		STR C15*W(TEMA)	04153	17670	04135
01276		RILJP L(FIXTC)	04154	60110	04152
01277	INTERR	RJP FIXTC	04155	65000	04152
01300	FDT0BCD	RESERVE 1	04156	0000	00000
01301		ENT B1*4	04157	12100	00004
01302		CL W(ANZ)	04160	16030	04174
01303	FDT0BCD1	CL A	04161	11000	00000
01304		LSH AQ*6	04162	07000	00006
01305		ENT B2*A	04163	12270	00000
01306		ENT A*W(BCDTBL*82)	04164	11032	04175
01307		LSH AQ*540	04165	07000	00066
01310		ENT A*W(ANZ)	04166	11030	04174
01311		LSH AQ*6	04167	07000	00006
01312		STR A*W(ANZ)	04170	15030	04174
01313		SJF B1*FDT0BCD1	04171	72100	04161
01314		ENT Q*W(ANZ)	04172	10030	04174
01315		JP L(FDT0BCD)	04173	61010	04156
01316	ANZ	RESERVE 1	04174	0000	00000
01317	BCDTBL	60	04175	0000	00060
01320		0	04176	0000	00000
01321		0	04177	0000	00000
01322		0	04200	0000	00000
01323		0	04201	0000	00000
01324		60	04202	0000	00060
01325		21	04203	0000	00021
01326		22	04204	0000	00022
01327		23	04205	0000	00023
01330		24	04206	0000	00024
01331		25	04207	0000	00025
01332		26	04210	0000	00026
01333		27	04211	0000	00027
01334		30	04212	0000	00030
01335		31	04213	0000	00031
01336		41	04214	0000	00041

.	01337	42	04215	00000	00042
.	01340	43	04216	00000	00043
.	01341	44	04217	00000	00044
.	01342	45	04220	00000	00045
.	01343	46	04221	00000	00046
.	01344	47	04222	00000	00047
.	01345	50	04223	00000	00050
.	01346	51	04224	00000	00051
.	01347	62	04225	00000	00062
.	01350	63	04226	00000	00063
.	01351	64	04227	00000	00064
.	01352	65	04230	00000	00065
.	01353	66	04231	00000	00066
.	01354	67	04232	00000	00067
.	01355	70	04233	00000	00070
.	01356	71	04234	00000	00071
.	01357	55	04235	00000	00055
.	01360	52	04236	00000	00052
.	01361	32	04237	00000	00032
.	01362	0	04240	00000	00000
.	01363	35	04241	00000	00035
.	01364	0	04242	00000	00000
.	01365	0	04243	00000	00000
.	01366	53	04244	00000	00053
.	01367	54	04245	00000	00054
.	01370	75	04246	00000	00075
.	01371	0	04247	00000	00000
.	01372	0	04250	00000	00000
.	01373	0	04251	00000	00000
.	01374	0	04252	00000	00000
.	01375	73	04253	00000	00073
.	01376	60	04254	00000	00060
.	01377	0	04255	00000	00000
.	01400	1	04256	00000	00001
.	01401	2	04257	00000	00002
.	01402	3	04260	00000	00003
.	01403	4	04261	00000	00004
.	01404	5	04262	00000	00005
.	01405	6	04263	00000	00006
.	01406	7	04264	00000	00007
.	01407	10	04265	00000	00010
.	01410	11	04266	00000	00011
.	01411	0	04267	00000	00000
.	01412	0	04270	00000	00000
.	01413	61	04271	00000	00061
.	01414	33	04272	00000	00033
.	01415	34	04273	00000	00034
.	01416	0	04274	00000	00000

•	01417	SINEFUNCS	RESERVE 1	04275	00000	00000
•	01420		CL W(TEMB)	04276	16030	04136
•	01421		ENT Y-Q*4000000*ANEG	04277	31730	11506
•	01422		JP SINEFUNCS2	04300	61000	04304
•	01423		RPL Y+1*W(TEMB)	04301	36030	04136
•	01424		ENT Y-Q*10000000	04302	31030	11507
•	01425		RSH AQ*300	04303	03000	00036
•	01426	SINEFUNCS2	ENT Y-Q*20000000*ANEG	04304	31730	11510
•	01427		JP SINEFUNCS1	04305	61000	04310
•	01430		ENT Y-Q*4000000	04306	31030	11506
•	01431		RSH AQ*300	04307	03000	00036
•	01432	SINEFUNCS1	RJP SINEFUN	04310	65000	04325
•	01433		STR Q*W(TEMA)	04311	14030	04135
•	01434		ENT A*W(TEMB)*ANOT	04312	11530	04136
•	01435		JP SINEFUNCS3	04313	61000	04317
•	01436		CL Q	04314	10000	00000
•	01437		SUB Q*W(TEMA)	04315	27030	04135
•	01440		JP L(SINEFUNCS)	04316	61010	04275
•	01441	SINEFUNCS3	ENT Q*W(TEMA)	04317	10030	04135
•	01442		JP L(SINEFUNCS)	04320	61010	04275
•	01443	AZAMPLITUD	RESERVE 1	04321	00000	00000
•	01444	ELAMPLITUD	RESERVE 1	04322	00000	00000
•	01445	AZOMEGA	RESERVE 1	04323	00000	00000
•	01446	ELOMEGA	RESERVE 1	04324	00000	00000
•	01447	SINEFUN	RESERVE 1	04325	00000	00000
•	01450		STR Q*W(REVS)	04326	14030	04352
•	01451		MUL W(REVS)	04327	22030	04352
•	01452		RSH AQ*21D	04330	03000	00025
•	01453		STR Q*W(REVS2)	04331	14030	04353
•	01454		ENT Q*W(C9)	04332	10030	04360
•	01455		MUL W(REVS2)	04333	22030	04353
•	01456		RSH AQ*21D	04334	03000	00025
•	01457		ADD Q*W(C7)	04335	26030	04357
•	01460		MUL W(REVS2)	04336	22030	04353
•	01461		RSH AQ*21D	04337	03000	00025
•	01462		ADD Q*W(C5)	04340	26030	04356
•	01463		MUL W(REVS2)	04341	22030	04353
•	01464		RSH AQ*21D	04342	03000	00025
•	01465		ADD Q*W(C3)	04343	26030	04355
•	01466		MUL W(REVS2)	04344	22030	04353
•	01467		RSH AQ*21D	04345	03000	00025
•	01470		ADD Q*W(C1)	04346	26030	04354
•	01471		MUL W(REVS)	04347	22030	04352
•	01472		RSH AQ*21D	04350	03000	00025
•	01473	REVS	JP L(SINEFUN)	04351	61010	04325
•	01474	REVS2	RESERVE 1	04352	00000	00000
•	01475	REVS2	RESERVE 1	04353	00000	00000
•	01476	C1	62207732	04354	00622	07732

• 01477 C3	7265210412	04355	72652	10412
• 01500 C3	1214642567	04356	12146	42567
• 01501 C7	6633314703	04357	66333	14703
• 01502 C9	475534435	04360	04755	34435
• 01503	U-TAG AZPERIOD*180	04361	04417	00022
• 01504	U-TAG AZHEIGHT*180	04362	04420	00022
• 01505	U-TAG AZTIME*180	04363	04421	00022
• 01506 AZSTEP	RESERVE 1	04364	00000	00000
• 01507	ENT Q*W(THYME)	04365	10030	03713
• 01510	SUB Q*W(AZTIME)	04366	27030	04421
• 01511	CL A	04367	11000	00000
• 01512	DIV W(AZPERIOD)	04370	23030	04417
• 01513	SUB A*777*ANEG	04371	21700	00777
• 01514	JP AZSTEP1	04372	61000	04376
• 01515	ENT Q*W(AZHEIGHT)	04373	10030	04420
• 01516	RPL Y+Q*W(CONTBL)	04374	34030	01320
• 01517	JP L(AZSTEP)	04375	61010	04364
• 01520 AZSTEP1	ENT A*W(CONTBL)	04376	11030	01320
• 01521	JP L(AZSTEP)	04377	61010	04364
• 01522	U-TAG ELPERIOD*180	04400	04422	00022
• 01523	U-TAG ELHEIGHT*180	04401	04423	00022
• 01524	U-TAG ELTIME*180	04402	04424	00022
• 01525 ELSTEP	RESERVE 1	04403	00000	00000
• 01526	ENT Q*W(THYME)	04404	10030	03713
• 01527	SUB Q*W(ELTIME)	04405	27030	04424
• 01530	CL A	04406	11000	00000
• 01531	DIV W(ELPERIOD)	04407	23030	04422
• 01532	SUB A*777*ANEG	04410	21700	00777
• 01533	JP ELSTEP1	04411	61000	04415
• 01534	ENT Q*W(ELHEIGHT)	04412	10030	04423
• 01535	RPL Y+Q*W(CONTBL+1)	04413	34030	01321
• 01536	JP L(ELSTEP)	04414	61010	04403
• 01537 ELSTEP1	ENT A*W(CONTBL+1)	04415	11030	01321
• 01540	JP L(ELSTEP)	04416	61010	04403
• 01541 AZPERIOD	RESERVE 1	04417	00000	00000
• 01542 AZHEIGHT	RESERVE 1	04420	00000	00000
• 01543 AZTIME	RESERVE 1	04421	00000	00000
• 01544 ELPERIOD	RESERVE 1	04422	00000	00000
• 01545 ELHEIGHT	RESERVE 1	04423	00000	00000
• 01546 ELTIME	RESERVE 1	04424	00000	00000
• 01547	U-TAG AZPERIOD*180	04425	04417	00022
• 01550	U-TAG AZDURAT*180	04426	04512	00022
• 01551	U-TAG AZHEIGHT*180	04427	04420	00022
• 01552	U-TAG AZTIME*180	04430	04421	00022
• 01553 AZIMPULSE	RESERVE 1	04431	00000	00000
• 01554	ENT Q*W(THYME)	04432	10030	03713
• 01555	SUB Q*W(AZTIME)	04433	27030	04421
• 01556	STR Q*W(TEMA)	04434	14030	04135

•	01557	CL	A	04435	11000	00000
•	01560	DIV	W(AZPERIOD)	04436	21030	04417
•	01561	SUB	A*777*ANEG	04437	21700	00777
•	01562	JP	AZIMPULSE1	04440	61000	04444
•	01563	ENT	Q*W(AZHEIGHT)	04441	10030	04420
•	01564	RPL	Y+Q*W(CONTBL)	04442	34030	01320
•	01565	JP	L(AZIMPULSE)	04443	61010	04431
•	01566	ENT	Q*W(TENA)	04444	10030	04135
•	01567	SUB	Q*W(AZDURAT)	04445	27030	04512
•	01570	CL	A	04446	11000	00000
•	01571	DIV	W(AZPERIOD)	04447	21030	04417
•	01572	SUB	A*777*ANEG	04450	21700	00777
•	01573	JP	AZIMPULSE2	04451	61000	04455
•	01574	ENT	Q*W(AZHEIGHT)	04452	10030	04420
•	01575	RPL	Y+Q*W(CONTBL)	04453	35030	01320
•	01576	JP	L(AZIMPULSE)	04454	61010	04431
•	01577	ENT	A*W(CONTBL)	04455	11030	01320
•	01600	JP	L(AZIMPULSE)	04456	61010	04431
•	01601	U-TAG	ELPERIOD*18D	04457	04422	00022
•	01602	U-TAG	ELDURAT*18D	04460	04511	00022
•	01603	U-TAG	ELHEIGHT*18D	04461	04423	00022
•	01604	U-TAG	ELTIME*18D	04462	04424	00022
•	01605	RESERVE	1	04463	00000	00000
•	01606	ENT	Q*W(THME)	04464	10030	03713
•	01607	SUB	Q*W(ELTIME)	04465	27030	04424
•	01610	STR	Q*W(TENA)	04466	14030	04135
•	01611	CL	A	04467	11000	00000
•	01612	DIV	W(ELPERIOD)	04470	21030	04422
•	01613	SUB	A*777*ANEG	04471	21700	00777
•	01614	JP	ELIMPULSE1	04472	61000	04476
•	01615	ENT	Q*W(ELHEIGHT)	04473	10030	04423
•	01616	RPL	Y+Q*W(CONTBL+1)	04474	34030	01321
•	01617	JP	L(ELIMPULSE)	04475	61010	04463
•	01620	ENT	Q*W(TENA)	04476	10030	04135
•	01621	SUB	Q*W(ELDURAT)	04477	27030	04511
•	01622	CL	A	04500	11000	00000
•	01623	DIV	W(ELPERIOD)	04501	23030	04422
•	01624	SUB	A*777*ANEG	04502	21700	00777
•	01625	JP	ELIMPULSE2	04503	61000	04507
•	01626	ENT	Q*W(ELHEIGHT)	04504	10030	04423
•	01627	RPL	Y+Q*W(CONTBL+1)	04505	35030	01321
•	01630	JP	L(ELIMPULSE)	04506	61010	04463
•	01631	ENT	A*W(CONTBL+1)	04507	11030	01321
•	01632	JP	L(ELIMPULSE)	04510	61010	04463
•	01633	RESERVE	1	04511	00000	00000
•	01634	RESERVE	1	04512	00000	00000
•	01635	RESERVE	2049D	04513	00000	00000
•	01636	U-TAG	AZAMPLITUDE*21D	10514	04321	00025

01637	AZSINE	U-TAG	AZOMEGA*24D	10515	04323	00030
01640		RESERVE	1	10516	00000	00000
01641		STR	B1*L(TEMA)	10517	16110	04135
01642		ENT	Q*W(AZOMEGA)	10520	10030	04323
01643		MUL	W(THYME)	10521	22030	03713
01644		LSH	AQ*39D	10522	07000	00047
01645		ENT	LP*7777777	10523	40030	11511
01646		CL	Q	10524	10000	00000
01647		LSH	AQ*50D	10525	07000	00062
01650		ENT	B1*A	10526	12170	00000
01651		LSH	Q*10D	10527	05000	00012
01652		ENT	A*W(SINTBL*1+B1)	10530	11031	04514
01653		SUB	A*W(SINTBL*B1)	10531	21031	04513
01654		STR	A*W(TEMB)	10532	15030	04136
01655		MUL	W(TEMB)	10533	22030	04136
01656		RSH	AQ*10D	10534	03000	00012
01657		ADD	Q*W(SINTBL*B1)	10535	26031	04513
01660		MUL	W(ELAMPLITUDE)	10536	22030	04321
01661		LSH	AQ*6	10537	07000	00006
01662		ADD	A*W(AZST)	10540	20030	03711
01663		ENT	B1*L(TEMA)	10541	12110	04135
01664		JP	L(AZSINE)	10542	61010	10516
01665		U-TAG	ELAMPLITUDE*21D	10543	04322	00025
01666		U-TAG	ELOMEGA*24D	10544	04324	00030
01667	ELSINE	RESERVE	1	10545	00000	00000
01670		STR	B1*L(TEMA)	10546	16110	04135
01671		ENT	Q*W(ELOMEGA)	10547	10030	04324
01672		MUL	W(THYME)	10550	22030	03713
01673		LSH	AQ*39D	10551	07000	00047
01674		ENT	LP*7777777	10552	40030	11511
01675		CL	Q	10553	10000	00000
01676		LSH	AQ*50D	10554	07000	00062
01677		ENT	B1*A	10555	12170	00000
01700		LSH	Q*10D	10556	05000	00012
01701		ENT	A*W(SINTBL*1+B1)	10557	11031	04514
01702		SUB	A*W(SINTBL*B1)	10560	21031	04513
01703		STR	A*W(TEMB)	10561	15030	04136
01704		MUL	W(TEMB)	10562	22030	04136
01705		RSH	AQ*10D	10563	03000	00012
01706		ADD	Q*W(SINTBL*B1)	10564	26031	04513
01707		MUL	W(ELAMPLITUDE)	10565	22030	04322
01710		LSH	AQ*6	10566	07000	00006
01711		ADD	A*W(ELST)	10567	20030	03712
01712		ENT	B1*L(TEMA)	10570	12110	04135
01713		JP	L(ELSINE)	10571	61010	10545
01714		U-TAG	TEMA*0	10572	04135	00000
01715	ELRANDOM	RESERVE	1	10573	00000	00000
01716		ENT	A*W(ELST)	10574	11030	03712

•	01717	JP	L(ELRANDOM)	10375	61010	10573
•	01720	U-TAG	TEHA+0	10376	04135	00000
•	01721	RESERVE	1	10577	00000	00000
•	01722	ENT	A*(AZST)	10600	11030	03711
•	01723	JP	L(AZRANDOM)	10601	61010	10577
•	01724	RESERVE	1	10602	00000	00000
•	01725	RPL	Y+1*(PRINTINDIC)	10603	36030	01156
•	01726	ENT	B*(L(PRINTINDIC))	10604	12710	01156
•	01727	JP	L(JPTABLE+B7-1)	10605	61017	10605
•	01730	GETNUMS		10606	00000	10627
•	01731	0	BUKLEER	10607	00000	11461
•	01732	0	TIMECON	10610	00000	10736
•	01733	0	TIMECONB	10611	00000	10744
•	01734	0	AZINCON	10612	00000	10750
•	01735	0	AZINCONB	10613	00000	10756
•	01736	0	AZOUTCON	10614	00000	10762
•	01737	0	AZOUTCONB	10615	00000	10770
•	01740	0	AZDIFCON	10616	00000	10774
•	01741	0	AZDIFCONB	10617	00000	11002
•	01742	0	ELINCON	10620	00000	11006
•	01743	0	ELINCONB	10621	00000	11014
•	01744	0	ELOUTCON	10622	00000	11020
•	01745	0	ELOUTCONB	10623	00000	11026
•	01746	0	ELDIFCON	10624	00000	11032
•	01747	0	ELDIFCONB	10625	00000	11040
•	01750	0	RUNPRINTER	10626	00000	11044
•	01751	ENT	A*(THYME)	10627	11030	03713
•	01752	STR	A*(FIELDS)	10630	15030	10666
•	01753	ENT	Q*(AZIMUTH)	10631	10030	01331
•	01754	STR	Q*(FIELDS+80)*QPOS	10632	14230	10676
•	01755	SUB	Q*1	10633	27000	00001
•	01756	MUL	264	10634	22000	00264
•	01757	STR	Q*(FIELDS+1)	10635	14030	10667
•	01760	ENT	Q*(ELEVATION)	10636	10030	01332
•	01761	STR	Q*(FIELDS+100)*QPOS	10637	14230	10700
•	01762	SUB	Q*1	10640	27000	00001
•	01763	MUL	264	10641	22000	00264
•	01764	STR	Q*(FIELDS+4)	10642	14030	10672
•	01765	RJP	ENCODE	10643	65000	01146
•	01766	ENT	A*(AZOUT)	10644	11030	01333
•	01767	STR	A*(FIELDS+2)*APOS	10645	15630	10670
•	01770	ADD	A*1	10646	20000	00001
•	01771	STR	A*(FIELDS+90)	10647	15030	10677
•	01772	ENT	Q*(ELOUT)*QPOS	10650	10230	01334
•	01773	ADD	Q*1	10651	26000	00001
•	01774	STR	Q*(FIELDS+110)*QPOS	10652	14230	10701
•	01775	SUB	Q*1	10653	27000	00001
•	01776	MUL	264	10654	22000	00264

•	01777	STR	Q*W(FIELDS+5)	10655	14030	10673
•	02000	SUB	Q*W(FIELDS+4)	10656	27030	10672
•	02001	STR	Q*W(FIELDS+6)	10657	14030	10674
•	02002	ENT	Q*W(FIELDS+2)	10660	10030	10670
•	02003	MUL	264	10661	22000	00264
•	02004	STR	Q*W(FIELDS+2)	10662	14030	10670
•	02005	SUB	Q*W(FIELDS+1)	10663	27030	10667
•	02006	STR	Q*W(FIELDS+3)	10664	14030	10671
•	02007	JP	L(PRINTER)	10665	61010	10602
•	02010	RESERVE	12D	10666	00000	00000
•	02011	RESERVE	2	10702	00000	00000
•	02012	RESERVE	25D	10704	00000	00000
•	02013	777777777		10735	77777	77777
•	02014	ENT	A*W(FIELDS)	10736	11030	10666
•	02015	STR	A*W(NUMBER)	10737	15030	04144
•	02016	RJP	PRCONV1	10740	65000	11063
•	02017	ENT	A*W(FDVAR)	10741	11030	10702
•	02020	STR	A*W(PRBUFER+1)	10742	15030	10705
•	02021	JP	L(PRINTER)	10743	61010	10602
•	02022	RJP	FRACTCON	10744	65000	11103
•	02023	ENT	A*W(FDVAR+1)	10745	11030	10703
•	02024	STR	A*W(PRBUFER+2)	10746	15030	10706
•	02025	JP	L(PRINTER)	10747	61010	10602
•	02026	ENT	A*W(FIELDS+1)	10750	11030	10667
•	02027	STR	A*W(NUMBER)	10751	15030	04144
•	02030	RJP	PRCONV1	10752	65000	11063
•	02031	ENT	A*W(FDVAR)	10753	11030	10702
•	02032	STR	A*W(PRBUFER+4)	10754	15030	10710
•	02033	JP	L(PRINTER)	10755	61010	10602
•	02034	RJP	FRACTCON	10756	65000	11103
•	02035	ENT	A*W(FDVAR+1)	10757	11030	10703
•	02036	STR	A*W(PRBUFER+5)	10760	15030	10711
•	02037	JP	L(PRINTER)	10761	61010	10602
•	02040	ENT	A*W(FIELDS+2)	10762	11030	10670
•	02041	STR	A*W(NUMBER)	10763	15030	04144
•	02042	RJP	PRCONV1	10764	65000	11063
•	02043	ENT	A*W(FDVAR)	10765	11030	10702
•	02044	STR	A*W(PRBUFER+7)	10766	15030	10713
•	02045	JP	L(PRINTER)	10767	61010	10602
•	02046	RJP	FRACTCON	10770	65000	11103
•	02047	ENT	A*W(FDVAR+1)	10771	11030	10703
•	02050	STR	A*W(PRBUFER+8D)	10772	15030	10714
•	02051	JP	L(PRINTER)	10773	61010	10602
•	02052	ENT	A*W(FIELDS+3)	10774	11030	10671
•	02053	STR	A*W(NUMBER)	10775	15030	04144
•	02054	RJP	PRCONV1	10776	65000	11063
•	02055	ENT	A*W(FDVAR)	10777	11030	10702
•	02056	STR	A*W(PRBUFER+10D)	11000	15030	10716

02057	JP	L(PRINTER)	11001	61010	10602
02060	AZDIFCONB	RJP	FRAC1CON	11002	65000
02061		ENT	A*(F0VAR+1)	11003	11030
02062		STR	A*(PRBUFER+11D)	11004	15030
02063		JP	L(PRINTER)	11005	61010
02064	ELINCON	ENT	A*(F1ELDS+4)	11006	11030
02065		STR	A*(NUMBER)	11007	15030
02066		RJP	PRCONV1	11010	65000
02067		ENT	A*(F0VAR)	11011	11030
02070		STR	A*(PRBUFER+13D)	11012	15030
02071		JP	L(PRINTER)	11013	61010
02072	ELINCONB	RJP	FRAC1CON	11014	65000
02073		ENT	A*(F0VAR+1)	11015	11030
02074		STR	A*(PRBUFER+14D)	11016	15030
02075		JP	L(PRINTER)	11017	61010
02076	ELOUTCON	ENT	A*(F1ELDS+5)	11020	11030
02077		STR	A*(NUMBER)	11021	15030
02100		RJP	PRCONV1	11022	65000
02101		ENT	A*(F0VAR)	11023	11030
02102		STR	A*(PRBUFER+16D)	11024	15030
02103		JP	L(PRINTER)	11025	61010
02104	ELOUTCONB	RJP	FRAC1CON	11026	65000
02105		ENT	A*(F0VAR+1)	11027	11030
02106		STR	A*(PRBUFER+17D)	11030	15030
02107		JP	L(PRINTER)	11031	61010
02110	ELDIFCON	ENT	A*(F1ELDS+6)	11032	11030
02111		STR	A*(NUMBER)	11033	15030
02112		RJP	PRCONV1	11034	65000
02113		ENT	A*(F0VAR)	11035	11030
02114		STR	A*(PRBUFER+19D)	11036	15030
02115		JP	L(PRINTER)	11037	61010
02116	ELDIFCONB	RJP	FRAC1CON	11040	65000
02117		ENT	A*(F0VAR+1)	11041	11030
02120		STR	A*(PRBUFER+20D)	11042	15030
02121		JP	L(PRINTER)	11043	61010
02122	RUNPRINTER	ENT	A*(PRBCW)	11044	11030
02123		STR	A*(BCWPRINTER)	11045	15030
02124		ENT	A*(PRINTINTER)	11046	11030
02125		STR	A*(23)	11047	15030
02126		EX-FCT	C3*1201000001	11050	13170
02127		NO-OP		11051	12000
02130		OUT	C3*(BCWPRINTER)	11052	74170
02131		CL	W(PRINDIC)	11053	16030
02132		JP	L(PRINTER)	11054	61010
02133	PRBCW	U-TAG	PRINTBUFER+25D*PRINTBUFER	11055	10735
02134	PRINTBUFER	EQUALS	PRBUFER		
02135	BCWPRINTER	RESERVE	1	11056	00000
02136	PRINTINTER	RJP	PRINTINTER+1	11057	65000

•	02137	RESERVE 1		11060	00000 00000
•	02140	STR C3*W(ITEMA)		11061	17170 04135
•	02141	RILJP L(PRINTINTER+1)		11062	60110 11060
•	02142	RESERVE 1		11063	00000 00000
•	02143	CL W(FDVAR)		11064	16030 10702
•	02144	ENT A*WINUMBER)		11065	11030 04144
•	02145	CL Q		11066	10000 00000
•	02146	JP TROUBLE*ANES		11067	60700 11076
•	02147	TRBLFIXT		11070	03000 00022
•	02150	STR A*W(INTEGER)*APOS		11071	15630 11101
•	02151	CP Q		11072	14000 00000
•	02152	STR Q*W(FRACTION)		11073	14030 11102
•	02153	RJP INTEGERCON		11074	65000 11147
•	02154	JP L(PRCONV1)		11075	61010 11063
•	02155	TRUBLE		11076	15030 10702
•	02156	CP A		11077	15040 00000
•	02157	JP TRBLFIXT		11100	61000 11070
•	02160	RESERVE 1		11101	00000 00000
•	02161	FRACTION		11102	00000 00000
•	02162	FRACTCON		11103	00000 00000
•	02163	ENT Q*W(FRACTION)		11104	10030 11102
•	02164	LSH Q*29D		11105	05000 00035
•	02165	CL A		11106	11000 00000
•	02166	DIV W(TENTH)		11107	23030 11137
•	02167	STR Q*W(FRAC)		11110	14030 11143
•	02170	LSH AQ*30D		11111	07000 00036
•	02171	CL A		11112	11000 00000
•	02172	DIV W(TENTH+1)		11113	23030 11140
•	02173	STR Q*W(FRAC+1)		11114	14030 11144
•	02174	LSH AQ*30D		11115	07000 00036
•	02175	CL A		11116	11000 00000
•	02176	DIV W(TENTH+2)		11117	23030 11141
•	02177	STR Q*W(FRAC+2)		11120	14030 11145
•	02200	LSH AQ*30D		11121	07000 00036
•	02201	CL A		11122	11000 00000
•	02202	DIV W(TENTH+3)		11123	23030 11142
•	02203	LSH Q*24D		11124	05000 00030
•	02204	ENT A*W(FRAC+2)		11125	11030 11145
•	02205	LSH AQ*54D		11126	07000 00066
•	02206	ENT A*W(FRAC+1)		11127	11030 11144
•	02207	LSH AQ*54D		11130	07000 00066
•	02210	ENT A*W(FRAC)		11131	11030 11143
•	02211	LSH AQ*48D		11132	07000 00060
•	02212	ADD Q*60606060		11133	26030 11113
•	02213	LSH Q*6		11134	05000 00006
•	02214	STR Q*W(FDVAR+1)		11135	14030 10703
•	02215	JP L(FRACTCON)		11136	61010 11103
•	02216	TENTH		11137	03146 31463

•	02217	0024365605	11140	00243	65605
•	02220	0002030446	11141	00020	30446
•	02221	0000150667	11142	00001	50667
•	02222	FRAC	11143	00000	00000
•	02223	RESERVE 4	11147	00000	00000
•	02223	RESERVE 1	11147	00000	00000
•	02224	ENT Q*W(INTEGER)	11150	10030	11101
•	02225	CL A	11151	11000	00000
•	02226	DIV 10D	11152	23000	00012
•	02227	STR A*W(UNIT)	11153	15030	11201
•	02230	CL A	11154	11000	00000
•	02231	DIV 10D	11155	23000	00012
•	02232	LSH AQ*30D*ANOT	11156	07500	00036
•	02233	JP HUNDZERO	11157	61000	11172
•	02234	CL B7	11160	12700	00000
•	02235	LSH Q*24D	11161	05000	00030
•	02236	LSH AQ*12D	11162	07000	00014
•	02237	FIXTEN	11163	20030	11201
•	02240	ADD A*W(UNIT)	11164	07000	00006
•	02241	LSH AQ*6	11165	10330	10702
•	02242	ENT Q*W(FDVAR)*QNEG	11166	50137	11202
•	02243	SEL SET*W(GIMMICK+37)*SKIP	11167	50037	11205
•	02244	SEL SET*W(GIMMICK+B7+3)	11170	15030	10702
•	02245	STR A*W(FDVAR)	11171	61010	11147
•	02246	JP L(INTEGERCON)	11172	07500	00036
•	02246	HUNDZERO	11172	07500	00036
•	02247	JP TENZERO	11173	61000	11177
•	02250	ENT B7*1	11174	12700	00001
•	02251	LSH A*6	11175	06000	00006
•	02252	JP FIXTEN	11176	61000	11163
•	02253	ENT B7*2	11177	12700	00002
•	02254	JP FIXTEN	11200	61000	11163
•	02255	RESERVE 1	11201	00000	00000
•	02256	GIMMICK	11202	00606	06075
•	02257	0000606075	11203	00006	06075
•	02260	0000006075	11204	00000	06075
•	02261	4160606075	11205	41606	06075
•	02262	0041606075	11206	00416	06075
•	02263	0000416075	11207	00004	16075
•	02264	ENT A*W(DRIVINTERR)	11210	11030	11276
•	02265	STR A*W(53)	11211	15030	00053
•	02266	STR A*W(52)	11212	15030	00052
•	02267	STR A*W(73)	11213	15030	00073
•	02270	STR A*W(72)	11214	15030	00072
•	02271	ENT A*W(INTCLKTEST)	11215	11030	00140
•	02272	STR A*W(36)	11216	15030	00036
•	02273	OUT C13*W(UTAZBCW)*MONITOR	11217	76570	11304
•	02274	JP WEREHEREA-2	11220	61000	11220
•	02275	OUT C12*W(UTELBCW)*MONITOR	11221	76530	11305
•	02276	WEREHEREA	11222	61000	11222

02277	JP INITRET	11223	61000	00554
02300	RESERVE 1	11224	00000	00000
02301	ENT A*W(INTCLKTEST)	11225	11030	00140
02302	STR A*W(36)	11226	15030	00036
02303	ENT A*W(AZIMUTH)*APOS	11227	11630	01331
02304	ADD A*1	11230	20000	00001
02305	STR A*W(AZIMUTH)	11231	15030	01331
02306	ENT A*W(ELEVATION)*APOS	11232	11630	01332
02307	ADD A*1	11233	20000	00001
02310	STR A*W(ELEVATION)	11234	15030	01332
02311	OUT C13*W(UTAZBCW)	11235	74570	11304
02312	NO-OP	11236	12000	00000
02313	OUT C12*W(UTELBCW)*MONITOR	11237	76530	11305
02314	NO-OP	11240	12000	00000
02315	WEREHEREB	11241	61000	11241
02316	JP L(DRIVEREAL)	11242	61010	11224
02317	ENCODEREAL	11243	73570	11302
02320	IN C13*W(INAZBCW)	11244	12000	00000
02321	IN C12*W(INELBCW)	11245	73530	11303
02322	NO-OP	11246	12000	00000
02323	CL A	11247	11000	00000
02324	ENT Q*W(AZOUT)	11250	10030	01333
02325	LSH AQ*13*QPOS	11251	07200	00013
02326	LSH AQ*35*SKIP	11252	07100	00035
02327	LSH AQ*61*SKIP	11253	07100	00061
02330	RSH AQ*12*SKIP	11254	03100	00012
02331	STR Q*W(AZOUT)*SKIP	11255	14130	01333
02332	STR A*W(AZOUT)	11256	15030	01333
02333	ENT A*W(AZOUT)*APOS	11257	11630	01333
02334	SUB A*1	11260	21000	00001
02335	STR A*W(AZOUT)	11261	15030	01333
02336	CL A	11262	11000	00000
02337	ENT Q*W(ELOUT)	11263	10030	01334
02340	LSH AQ*13*QPOS	11264	07200	00013
02341	LSH AQ*35*SKIP	11265	07100	00035
02342	LSH AQ*61*SKIP	11266	07100	00061
02343	RSH AQ*12*SKIP	11267	03100	00012
02344	STR Q*W(ELOUT)*SKIP	11270	14130	01334
02345	STR A*W(ELOUT)	11271	15030	01334
02346	ENT A*W(ELOUT)*APOS	11272	11630	01334
02347	SUB A*1	11273	21000	00001
02350	STR A*W(ELOUT)	11274	15030	01334
02351	JP L(ENCODE)	11275	61010	01146
02352	DRIVFIX	11276	65000	11277
02353	RJP DRIVFIX+1	11277	00000	00000
02354	RESERVE 1	11300	36030	11277
02355	RPL Y+1*W(DRIVFIX+1)	11301	60110	11277
02356	RILJP L(DRIVFIX+1)			
	EQUALS DRIVFIX			
02356	DRIVINTERR			

02357	INAZBCV	U-TAG	AZOUT*AZOUT	11302	01333	01333
02360	INELBCV	U-TAG	ELOUT*ELOUT	11303	01334	01334
02361	UTAZBCV	U-TAG	AZIMUTH*AZIMUTH	11304	01331	01331
02362	UTELBCV	U-TAG	ELEVATION*ELEVATION	11305	01332	01332
02363	TYPEIN	RJP	TYPEIN+1	11306	65000	11307
02364		RESERVE	1	11307	00000	00000
02365		STR	AW(BLT)	11310	15030	11335
02366		ENT	AW(TYPT)	11311	11030	11334
02367		SUB	A*57*ANOT	11312	21500	00057
02370		RILJP	PROGRAM	11313	60100	00124
02371		ENT	AW(TYPT)	11314	11030	11334
02372		SUB	A*11*ANOT	11315	21500	00011
02373		JP	FIXDECPRT	11316	61000	11337
02374		ENT	AW(TYPT)	11317	11030	11334
02375		SUB	A*24*ANOT	11320	21500	00024
02376		JP	FIXOCTPRNT	11321	61000	11336
02377		ENT	AW(TYPT)	11322	11030	11334
02400		SUB	A*30*ANOT	11323	21500	00030
02401		JP	STOPRINT	11324	61000	11344
02402		ENT	AW(TYPT)	11325	11030	11334
02403		SUB	A*25*ANOT	11326	21500	00025
02404		JP	GOPRINT	11327	61000	11345
02405	ZOTZ	IN	C2*W(TINBUF)*MONITOR	11330	75130	11333
02406		ENT	AW(BLT)	11331	11030	11335
02407		RILJP	L(TYPEIN+1)	11332	60110	11307
02410	TINBUF	U-TAG	TYPT*TYPT	11333	11334	11334
02411	TYPT	RESERVE	1	11334	00000	00000
02412	BLT	RESERVE	1	11335	00000	00000
02413	FIXOCTPRNT	ENT	A*W(EIGHTGO)*SKIP	11336	11130	11342
02414	FIXDECPRT	ENT	A*W(DECGO)	11337	11030	11343
02415		STR	AW(JPTABLE-1)	11340	15030	10605
02416		JP	ZOTZ	11341	61000	11330
02417	EIGHTGO	JP	L(JPTABLEOCT*87-1)	11342	61017	11354
02420	DECGO	JP	L(JPTABLE*87-1)	11343	61017	10605
02421	STOPRINT	ENT	A*W(STOPPER)*SKIP	11344	11130	11351
02422	GOPRINT	ENT	A*W(GOER)	11345	11030	11352
02423		STR	AW(JPTABLE+16D)	11346	15030	10626
02424		STR	AW(JPTABLEOCT+16D)	11347	15030	11375
02425		JP	ZOTZ	11350	61000	11330
02426	STOPPER	O	RUNNY	11351	00000	11353
02427	GOER	O	RUNPRINTER	11352	00000	11044
02430	RUNNY	CL	W(PRINTINDIC)	11353	16030	01156
02431		JP	L(PRINTER)	11354	61010	10602
02432	JPTABLEOCT	O	GETNUNS	11355	00000	10627
02433		O	BUFKLEER	11356	00000	11461
02434		O	TIMECON	11357	00000	10736
02435		O	TIMECONB	11360	00000	10744
02436		O	AZINCON	11361	00000	10750

02437	0	AZINCONB	11362	00000	10756
02440	0	ELINCONB	11363	00000	11006
02441	0	ELINCONB	11364	00000	11014
02442	0	AZINOCT	11365	00000	11376
02443	0	AZOUTOCT	11366	00000	11406
02444	0	ELINOCT	11367	00000	11416
02445	0	ELOUTOCT	11370	00000	11426
02446	0	AZDIFOCT	11371	00000	11464
02447	0	ELDIFOCT	11372	00000	11473
02450	0	RUNNY+1	11373	00000	11354
02451	0	RUNNY+1	11374	00000	11354
02452	0	RUNPRINTER	11375	00000	11044
02453	ENT	A*W(FIELDS+8D)	11376	11030	10676
02454	STR	A*W(NUMBER)	11377	15030	04144
02455	RJP	CONOCT	11400	65000	11436
02456	ENT	A*W(FDVAR)	11401	11030	10702
02457	STR	A*W(PRBUFER+7)	11402	15030	10713
02460	ENT	A*W(FDVAR+1)	11403	11030	10703
02461	STR	A*W(PRBUFER+8D)	11404	15030	10714
02462	JP	L(PRINTER)	11405	61010	10602
02463	ENT	A*W(FIELDS+9D)	11406	11030	10677
02464	STR	A*W(NUMBER)	11407	15030	04144
02465	RJP	CONOCT	11410	65000	11436
02466	ENT	A*W(FDVAR)	11411	11030	10702
02467	STR	A*W(PRBUFER+10D)	11412	15030	10716
02470	ENT	A*W(FDVAR+1)	11413	11030	10703
02471	STR	A*W(PRBUFER+11D)	11414	15030	10717
02472	JP	L(PRINTER)	11415	61010	10602
02473	ENT	A*W(FIELDS+10D)	11416	11030	10700
02474	STR	A*W(NUMBER)	11417	15030	04144
02475	RJP	CONOCT	11420	65000	11436
02476	ENT	A*W(FDVAR)	11421	11030	10702
02477	STR	A*W(PRBUFER+16D)	11422	15030	10724
02500	ENT	A*W(FDVAR+1)	11423	11030	10703
02501	STR	A*W(PRBUFER+17D)	11424	15030	10725
02502	JP	L(PRINTER)	11425	61010	10602
02503	ENT	A*W(FIELDS+11D)	11426	11030	10701
02504	STR	A*W(NUMBER)	11427	15030	04144
02505	RJP	CONOCT	11430	65000	11436
02506	ENT	A*W(FDVAR)	11431	11030	10702
02507	STR	A*W(PRBUFER+19D)	11432	15030	10727
02510	ENT	A*W(FDVAR+1)	11433	11030	10703
02511	STR	A*W(PRBUFER+20D)	11434	15030	10730
02512	JP	L(PRINTER)	11435	61010	10602
02513	CONOCT	RESERVE 1	11436	00000	00000
02514	CL	A	11437	11000	00000
02515	STR	B6*L(TEMA)	11440	16610	04135
02516	ENT	Q*W(NUMBER)	11441	10030	04144

•	02517	ENT	B6*4	11442	12600	00004	
•	02520	LSH	A*3	11443	06000	00003	
•	02521	LSH	AQ*3	11444	07000	00003	
•	02522	ADD	A*60	11445	20000	00060	
•	02523	BJP	B6*CONOCT+5	11446	72600	11443	
•	02524	STR	A*W(FDVAR)	11447	15030	10702	
•	02525	CL	A	11450	11000	00000	
•	02526	ENT	B6*4	11451	12600	00004	
•	02527	LOWHALF	LSH	A*3	11452	06000	00003
•	02530	LSH	AQ*3	11453	07000	00003	
•	02531	ADD	A*60	11454	20000	00060	
•	02532	BJP	B6*LOWHALF	11455	72600	11452	
•	02533	STR	A*W(FDVAR+1)	11456	15030	10703	
•	02534	ENT	B6*L(TEMA)	11457	12610	04135	
•	02535	JP	L(CONOCT)	11460	61010	11436	
•	02536	BUFKLEER	CLEAR	25D*PRBUFER	11461	70100	00031
•	02537	JP	L(PRINTER)	11462	16030	10704	
•	02540	AZDIFOCT	ENT	A*W(FIELDS+8D)	11463	61010	10602
•	02541	SUB	A*W(FIELDS+9D)	11464	11030	10676	
•	02542	STR	A*W(NUMBER)	11465	21030	10677	
•	02543	RJP	CONOCT	11466	15030	04144	
•	02544	ENT	A*W(FDVAR+1)	11467	65000	11436	
•	02545	STR	A*W(PRBUFER+22D)	11470	11030	10703	
•	02546	JP	L(PRINTER)	11471	15030	10732	
•	02547	ELDIFOCT	ENT	A*W(FIELDS+10D)	11472	61010	10602
•	02550	SUB	A*W(FIELDS+11D)	11473	11030	10700	
•	02551	STR	A*W(NUMBER)	11474	21030	10701	
•	02552	RJP	CONOCT	11475	15030	04144	
•	02553	ENT	A*W(FDVAR+1)	11476	65000	11436	
•	02554	STR	A*W(PRBUFER+24D)	11477	11030	10703	
•	02555	JP	L(PRINTER)	11500	15030	10734	
•				11501	61010	10602	
•				11502	02300	00002	
•				11503	02000	00002	
•				11504	56000	00000	
•				11505	21100	00002	
•				11506	00040	00000	
•				11507	00100	00000	
•				11510	00020	00000	
•				11511	00077	77777	
•				11512	12010	00001	
•				11513	00606	06060	

ANTENATEST LDMASSEY*24JUN1964

LABEL	LOC	LABEL	LOC	LABEL	LOC
AS\$S\$1111	00011	AS\$S\$1112	00001	AS\$S\$1113	00037
AS\$S\$1114	00024	AS\$S\$1115	00047	AS\$S\$1116	00043
AS\$S\$1117	00120	AS\$S\$1118	00103	AS\$S\$1119	11502
AS\$S\$111A	00163	AS\$S\$111B	00155	AS\$S\$111C	11503
AS\$S\$111D	00211	AS\$S\$111E	00204	AS\$S\$111F	00276
AS\$S\$111G	00265	AS\$S\$111H	00316	AS\$S\$111I	00306
AS\$S\$111J	00326	AS\$S\$111K	00322	AS\$S\$111L	11504
AS\$S\$111M	00450	AS\$S\$111N	00440	AS\$S\$111O	00460
AS\$S\$111P	00454	AS\$S\$111Q	00543	AS\$S\$111R	00531
AS\$S\$111S	01031	AS\$S\$111T	01023	AS\$S\$111U	01056
AS\$S\$111V	01046	AS\$S\$111W	11305	AS\$S\$111X	11506
AS\$S\$111Y	11507	AS\$S\$111Z	11510	AS\$S\$1121	11511
AS\$S\$1122	11512	AS\$S\$1123	11513	ABCW	01110
ACCUM	04150	ACSTORE	01132	AGAINX	00302
AGAINXY	00367	AGAINY	00305	AGAINZ	00332
AMINUS	04073	ANGLESAVE	01327	ANTENTRY	00000
ANZ	04174	ARG1	03645	ARG10	03700
ARG11	03703	ARG12	03706	ARG2	03650
ARG3	03653	ARG4	03656	ARG5	03661
ARG6	03664	ARG7	03667	ARG8	03672
ARG9	03675	ARGLOOP	00476	ASAVE	04141
AX	04002	AZOMEGA	04323	AZOUT	01333
AZOUTOCT	11406	AZOUTCON	10762	AZOUTCONB	10770
AZAMPLITUD	04321	AZDIFOCT	11464	AZDIFCON	10774
AZDIFCONB	11002	AZDURAT	04512	AZHEIGHT	04420
AZIMPULSE	04431	AZIMPULSE1	04444	AZIMPULSE2	04455
AZIMUTH	01331	AZINOCT	11376	AZINCON	10750
AZINCONB	10756	AZPOLY	03757	AZPOLYLOOP	03770
AZPERIOD	04417	AZRANDOM	10577	AZSINE	10516
AZST	03711	AZSTEP	04364	AZSTEP1	04376
AZTIME	04421	BANG	00022	BARGLOOP	00472
BBCW	01111	BBDTBL	04175	BCW	01113
BCWPRINTER	11056	BINEG	04115	BINPNT	04147
BINSCALE	04106	BLT	11335	BSAVE	04142
BUFA	01335	BUFB	02465	BUFDONE	00642
BUFKLEER	11461	CODEDELETE	00370	COMMA	00336
CONOCT	11436	CONDEIN	00147	CONIN1	00172
CONINETC	00203	CONDTBL	01320	CONTIND	03615
C1	04354	C3	04355	C5	04356
C7	04357	C9	04360	CBCW	01112
CLKTEST	01244	CLBUFA	00676	CYCLE	00377

DECON	04017	DECO	11343	DECIMAL	04071
DECRET	04064	DESIGNFLG	04133	DEGCON	01114
DRIVE	01135	DRIVE1	01141	DRIVE2	01145
DRIVEREAL	11224	DRIVFIX	11276	DRIVINIT	11210
DRIVINTERR	11276	EIGHTGO	11342	ELOMEGA	04324
ELOUT	01334	ELOUTOCT	11426	ELOUTCON	11020
ELOUTCONB	11026	ELAMPLITUD	04322	ELDIFOCF	11473
ELDIFCON	11032	ELDIFCONB	11040	ELDURAT	04511
ELEVATION	01332	ELHEIGHT	04423	ELIMPULSE	04463
ELIMPULSE1	04476	ELIMPULSE2	04507	ELINOCT	11416
ELINCON	11006	ELINCONB	11014	ELPOLY	03727
ELPOLYLOOP	03740	ELPERIOD	04422	ELRANDOM	10573
ELSINE	10545	ELST	03712	ELSTEP	04403
ELSTEP1	04415	ELTIME	04424	ENCODE	01146
ENCODEREAL	11243	ENCODEX	01151	FOUND	00464
FACTOR	01134	FAZI	03637	FDT08CD	04156
FDT08CD1	04161	FDVAR	10702	FELE	03642
FIDGE	00551	FIDGET	00604	FIDGETTE	00637
FIELDS	10666	FIRST	04134	FIRSTPOSIT	00601
FIXOCTPRNT	11336	FIXDECPRT	11337	FIXTC	04152
FIXTEN	11163	FRAC	11143	FRACTCON	11103
FRACTION	11102	FREQOUT	01311	FUNADDTBL	01222
FUNCTBL	01202	FUNIDLOOP	00426	FUNLOC	03616
FUNSEARCH	00430	GOODY	04046	GOER	11352
GOPRINT	11345	GETNUMS	10627	GIMMICK	11202
HUNDZERO	11172	INAZBCW	11302	INELBCW	11303
INITRET	00554	INPUTBUFER	01245	INTCLKTEST	00140
INTCLKTSTA	00137	INTEGER	11101	INTEGERCON	11147
INTERR	04155	IWRITE	03720	IWRITEFD	03634
JPTABLE	10606	JPTABLEOCT	11355	LOOPA	04031
LOOPB	04034	LOWHALF	11452	LINEERR	00264
MAIN	00014	NOMORE	01022	NOSCALE	04104
NAIMPULSE	00004	NAPOLY	00006	NARANDOM	00001
NASINE	00002	NASTEP	00003	NDEC	04151
NEXT	00475	NEXTX	00517	NFIELDS	01317
NRUN	01326	NUMBER	04144	NWAIT	01325
POINTGEN	00613	POLYB	04016	PHI	03715
PHIFD	03623	PROCEEDTAP	01107	PROCEEDX	00237
PROGRAM	00124	PRBCW	11055	PRBUFER	10704
PRCONV1	11063	PRINTBUFER	10704	PRINTER	10602
PRINTINDIC	01156	PRINTINTER	11057	PRINTRET	00650
PRINTRETEX	00646	QSAVE	04143	QSTORE	01133
REACCEPT	00052	REVS	04352	REV52	04353
RUNNY	11353	RUNPRINTER	11044	SAMEVALUE	00420
SCALING	04075	SIGNFIX	04121	SINECALC	00015
SINEFUN	04325	SINEFUNCS	04275	SINEFUNCS1	04310
SINEFUNCS2	04304	SINEFUNCS3	04317	SINTBL	04513
STOPMARK	10735	STOPPER	11351	STOPRINT	11344

TABLE	01157	TAPEWRITE	01075	TEHA	04135
TEMAX	01315	TEMB	04136	TEHAX	01312
TEMC	04137	TEMCX	01316	TENPOWER	04140
TENTH	11137	TENZERO	11177	THETA	03714
THETAFO	03620	THRU	04126	THYME	03713
THYMEX	04001	TIME	01330	TIMECON	10736
TIMECONB	10744	TINBUF	11333	TROUBLE	11076
TRBLFIAT	11070	TRUN	03717	TRUNFD	03631
TWAIT	03716	TWAITFD	03626	TYPEIN	11306
TYPT	11334	UNFULLA	01015	UNFULLB	00755
UNIT	11201	USEBUFA	00762	UTAZBCW	11304
UTELBCW	11305	VIRGULE	00375	WEREHEREA	11222
WEREHEREB	11241	WRITESUF	00706	WRITELINE	00703
ZOTZ	11330	ZERO	00000	ZKFLDCNT	00547
ZXNLINEIND	01242	ZXYZ	00700	ZZZZ	00665

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ANTENATEST

LABEL	LOC	LABEL	LOC	LABEL	LOC
ZERO	00000	ANTENTRY	00000	NARANDOM	00001
AS\$S\$1112	00001	NASINE	00002	NASTEP	00003
NAIMPULSE	00004	NAPOLY	00006	AS\$S\$1111	00011
MAIN	00014	SINCEALC	00015	BANG	00022
AS\$S\$1114	00024	AS\$S\$1113	00037	AS\$S\$1116	00043
AS\$S\$1115	00047	REACCEPT	00052	AS\$S\$1118	00103
AS\$S\$1117	00120	PROGRAM	00124	INTCLKTSTA	00137
INTCLKTEST	00140	CONIN	00147	AS\$S\$1118	00155
AS\$S\$111A	00163	CONIN1	00172	CONINETC	00203
AS\$S\$111E	00204	AS\$S\$111D	00211	PROCEEDX	00237
LINERROR	00264	AS\$S\$111G	00265	AS\$S\$111F	00276
AGAINX	00302	AGAINY	00305	AS\$S\$1111	00306
AS\$S\$111H	00316	AS\$S\$111K	00322	AS\$S\$111J	00326
AGAINZ	00332	COMMA	00336	AGAINXY	00367
CODEDELETE	00370	VIRGULE	00375	CYCLE	00377
SAMEVALUE	00420	FUNIDLOOP	00426	FUNSEARCH	00430
AS\$S\$111N	00440	AS\$S\$111M	00450	AS\$S\$111P	00454
AS\$S\$1110	00460	FOUND	00464	BARGLOOP	00472
NEXT	00475	ARGLOOP	00476	NEXTX	00517
AS\$S\$111R	00531	AS\$S\$111Q	00543	ZKFLOCNT	00547
FIDGE	00551	INITRET	00554	FIRSTPOSIT	00601
FIDGEY	00604	POINTGEN	00613	FIDGETTE	00637
BUFDONE	00642	PRINTRETEX	00646	PRINTRET	00650
ZZZ	00665	CLRBUFA	00676	ZXYZ	00700
WITELINE	00703	WRITEBUF	00706	UNFULLB	00755
USEBUFA	00762	UNFULLA	01015	NOMORE	01022
AS\$S\$111T	01023	AS\$S\$111S	01031	AS\$S\$111V	01046
AS\$S\$111U	01056	TAPEWRITE	01075	PROCEEDTAP	01107
ABCW	01110	BBCW	01111	CBCW	01112
BCW	01113	DEGCON	01114	ACSTORE	01132
QSTORE	01133	FACTOR	01134	DRIVE	01135
DRIVE1	01141	DRIVE2	01145	ENCODE	01146
ENCODEX	01151	PRINTINDIC	01156	TABLE	01157
FUNCTBL	01202	FUNADOTBL	01222	ZXNLINEIND	01242
CLKTEST	01244	INPUTBUFER	01245	FREQOUT	01311
TEMBX	01312	TEMAX	01315	TEMCX	01316
NFIELDOS	01317	CONTEBL	01320	NWAIT	01325
NRUN	01326	ANGLESAVE	01327	TIME	01330
AZIMUTH	01331	ELEVATION	01332	AZOUT	01333
ELOUT	01334	BUFA	01335	BUFB	02465
CONTIND	03615	FUNLOC	03616	THETAFO	03620

PHIFD	03623	TWITFD	03626	TRUNFD	03631
IWRITEFD	03634	FAZI	03637	FEL	03642
ARG1	03645	ARG2	03650	ARG3	03653
ARG4	03656	ARG5	03661	ARG6	03664
ARG7	03667	ARG8	03672	ARG9	03675
ARG10	03700	ARG11	03703	ARG12	03706
AZST	03711	ELST	03712	THYME	03713
THETA	03714	PHI	03715	TWAIT	03716
TRUN	03717	IWRITE	03720	ELPOLY	03727
ELPOLYLOOP	03740	AZPOLY	03757	AZPOLYLOOP	03770
THYMEX	04001	AX	04002	POLYB	04016
DECON	04017	LOOPA	04031	LOOPB	04034
GOODY	04046	DECRET	04064	DECIMAL	04071
AMINUS	04073	SCALING	04075	NOSCALE	04104
BINSCALE	04106	BINEG	04115	SIGNFIX	04121
THRU	04126	DECSIGNFLG	04133	FIRST	04134
TEMA	04135	TEMB	04136	TEMC	04137
TENPOWER	04140	ASAVE	04141	BSAVE	04142
QSAVE	04143	NUMBER	04144	BINPNT	04147
ACCUM	04150	NDEC	04151	FIXTC	04152
INTERR	04155	FDT0BCD	04156	FDT0BCD1	04161
ANZ	04174	BCDTBL	04175	SINEFUNCS	04275
SINEFUNCS2	04304	SINEFUNCS1	04310	SINEFUNCS3	04317
AZAMPLITUD	04321	ELAMPLITUD	04322	AZOMEGA	04323
ELOMEGA	04324	SINEFUN	04325	REVS	04352
REVS2	04353	C1	04354	C3	04355
C5	04356	C7	04357	C9	04360
AZSTEP1	04364	AZSTEP1	04376	ELSTEP	04403
ELSTEP1	04415	AZPERIOD	04417	AZHEIGHT	04420
AZTIME	04421	ELPERIOD	04422	ELHEIGHT	04423
ELTIME	04424	AZIMPULSE	04431	AZIMPULSE1	04444
AZIMPULSE2	04455	ELIMPULSE	04463	ELIMPULSE1	04476
ELIMPULSE2	04507	ELDURAT	04511	AZDURAT	04512
SINTBL	04513	AZSINE	10516	ELSINE	10545
ELRANDOM	10573	AZRANDOM	10577	PRINTER	10602
JPTABLE	10606	GETNUMS	10627	FIELDS	10666
FDVAR	10702	PRINTBUFFER	10704	PRBUFER	10704
STOPMARK	10735	TIMECON	10736	TIMECONB	10744
AZINCON	10750	AZINCONB	10756	AZOUTCONB	10762
AZOUTCONB	10770	AZDIFCON	10774	AZDIFCONB	11002
ELINCON	11006	ELINCONB	11014	ELOUTCON	11020
ELOUTCONB	11026	ELDIFCON	11032	ELDIFCONB	11040
RUNPRINTER	11044	PRBCW	11052	BCWPRINTER	11056
PRINTINTER	11057	PRCONV1	11063	TRBLFIXT	11070
TROUBLE	11076	INTEGER	11101	FRACTION	11102
FRACTCON	11103	TENTH	11137	FRAC	11143
INTEGERCON	11147	FIXTEN	11163	HUNDZERO	11172
TENZERO	11177	UNIT	11201	GIMMICK	11202

DRIVINIT	11210	WEREHEREA	11222	DRIVERREAL	11224
WEREHEREB	11241	ENCODEREAL	11243	DRIVFIX	11276
DRIVINTERR	11276	INAZBCW	11302	INELBCW	11303
UTAZBCW	11304	UTELBCW	11305	TYPEIN	11306
ZOTZ	11330	TINBUF	11333	TYPT	11334
BLT	11335	FIXOCTPRNT	11336	FIXOCTPRNT	11337
EIGHTGO	11342	DECGO	11343	STOPPRINT	11344
GOPRINT	11345	STOPPER	11351	GOER	11352
RUNNY	11353	JPTABLEOCT	11355	AZINOC	11376
AZOUTOCT	11406	ELINOC	11416	ELQUTOCT	11426
CONOC	11436	LOWHALF	11452	BUFKLEER	11461
AZDIFOCT	11464	ELDIFOCT	11473	AS\$S\$1119	11502
AS\$S\$111C	11503	AS\$S\$111L	11504	AS\$S\$111W	11505
AS\$S\$111X	11506	AS\$S\$111Y	11507	AS\$S\$111Z	11510
AS\$S\$1121	11511	AS\$S\$1122	11512	AS\$S\$1123	11513

APPENDIX B
7094 PRINT PROGRAM

```

*      LIST8
CCONVERT
C      THIS PROGRAM READS A TAPE PREPARED ON THE UNIVAC 490 AND PRINTS IT
C      WITH SOME SMALL CALCULATIONS
      DIMENSION BUFFER(500 ),DIFFER(200),BUFFRX(500)
      READ INPUT TAPE 2,100,NTIM
100  FORMAT (I10)
      DO 101 III=1,NTIM
10   IOF=0
      CALL READER (BUFFRX(5),5,IOF)
      DO 102 NN=1,5
      NNNN=6-NN
102  BUFFER(NN)=BUFFRX(NNNN)
      WRITE OUTPUT TAPE 6,20,(BUFFER(L),L=1,5)
20   FORMAT (5A6)
      READ INPUT TAPE 2,6,N
6    FORMAT (I10)
      M=0
12   CALL READER (BUFFRX(500),500,IOF)
      IF (IOF) 11,104,11
104  DO 103 NN=1,500
      NNNN=501-NN
103  BUFFER(NN)=BUFFRX(NNNN)
      DO 2 LDEX=1,500
2    CALL FLOTER (BUFFER(LDEX))
      DO 3 LDEX=1,496,5
      BUFFER(LDEX)=BUFFER(LDEX)*.004
      DO 4 NDEX=1,4
      JDEX=LDEX+NDEX
4    BUFFER(JDEX)=BUFFER(JDEX)*.000686645507
3    CONTINUE
      DO 5 LDEX=1,100
      JDEX=2*LDEX-1
      NDEX=5*LDEX-3
      MDEX=NDEX+1
      DIFFER(JDEX)=BUFFER(NDEX)-BUFFER(MDEX)
5    DIFFER(JDEX+1)=BUFFER(NDEX+2)-BUFFER(MDEX+2)
      DO 7 LDEX=1,100
      JDEX=XMODF(M,N)
      M=M+1
      IF (JDEX) 7,8,7
8    NDEX=5*LDEX-4
      IDEX=2*LDEX-1
      NXDEX=NDEX+4
      IXDEX>IDEX+1
      WRITE OUTPUT TAPE 6,9,((BUFFER(I),I=NDEX,NXDEX),(DIFFER(I),I>IDEX,
1 IXDEX))
9    FORMAT (9X,5F15.5,2E15.8)
7    CONTINUE
      GO TO 12
11   END FILE 7
101  CONTINUE
      CALL EXIT
      END
      FAP

```

APPENDIX C
7094 PLOT PROGRAM

```

*      LIST8
CPLOTTER
C      THIS PROGRAM ACCEPTS THE CONVERTED UNIVAC 490 TAPE AND PLOTS THE
C      DATA IN ACCORDANCE WITH THE INPUT SPECIFICATIONS.
      DIMENSION BUFFER(1000),BUFRIN(500),BUFXIN(500),DIFFER(200),
1      PLOTB1(5000),PLOTB2(5000),PLOTB3(5000),PLOTB4(5000),XLABEL(5),XLABSR(5),XLEN(5)
      PRINT 15
      WRITE OUTPUT TAPE 3,15
15  FORMAT (46H1MOUNT INPUT TAPE ON A7 AND SCRATCH TAPE ON A6)
      PAUSE 70707
      READ INPUT TAPE 2,1,NGRAPH
1  FORMAT (I10)
      XSTA=0.0
      YLEN=6.0
      CALL PLOTS (BUFFER(1000),1000)
      NGR=((NGRAPH-1)/3)+1
      DO 2 I=1,NGR
      CALL PLOT (0.0,-29.0,-3)
      CALL PLOT (0.0,2.5,-3)
      DO 3 J=1,3
      NTEST=((I-1)*3)+J
      YSTA=0.0
      REWIND 7
      READ INPUT TAPE 2,21,(XLABSR(L),L=1,5)
      READ INPUT TAPE 2,4,JTEST,SPACE,TIML,TIMU,XLEN(J),IUJ
21  FORMAT (5A6)
      4  FORMAT (I10,4F10.0,I10)
25  CALL READER (BUFXIN(5),5,IOF)
      DO 100 NN=1,5
      NNNN=6-NN
100  XLABEL(NN)=BUFXIN(NNNN)
      DO 22 L=1,5
B   XLABEL(L)=(XLABEL(L)*(-XLABSR(L)))+(XLABSR(L)*(-XLABEL(L)))
      IF (XLABEL(L)) 23,22,23
22  CONTINUE
      GO TO 24
23  CALL FILSPA
      GO TO 25
24  KN=1
240  INDIC=1
      CALL READER (BUFXIN(500),500,IOF)
      IF (IOF) 205,206,205
206  DO 207 NN=1,500
      NNNN=501-NN
207  BUFRIN(NN)=BUFXIN(NNNN)
      DO 208 LDEX=1,500
208  CALL FLÖTER (BUFRIN(LDEX))
      DO 209 LDEX=1,496,5
      BUFRIN(LDEX)=BUFRIN(LDEX)*.004
      DO 210 NDEX=1,4
      JDEX=NDEX+LDEX
210  BUFRIN(JDEX)=BUFRIN(JDEX)*.0006866+5507
209  CONTINUE
      DO 211 LDEX=1,100
      JDEX=2*LDEX-1
      NDEX=5*LDEX-3
      MDEX=NDEX+1

```



```

DIFFER(JDEX)=BUFRIN(NDEX)-BUFRIN(MDEX)
211 DIFFER(JDEX+1)=BUFRIN(NDEX+2)-BUFRIN(MDEX+2)
218 DO 212 LDEX=INDIC,496,5
    IF(BUFRIN(LDEX)-TIML) 212,213,213
212 CONTINUE
    GO TO 240
213 INDIC=LDEX
    TIML=TIML+SPACE
    PLOTB1(KN)=BUFRIN(INDIC)
    LDEX=(2*(INDIC-1)/5)+1
    IF(JTEST) 214,215,214
214 PLOTB2(KN)=BUFRIN(INDIC+3)
    PLOTB3(KN)=BUFRIN(INDIC+4)
    PLOTB4(KN)=DIFFER(LDEX+1)
    GO TO 216
215 PLOTB2(KN)=BUFRIN(INDIC+1)
    PLOTB3(KN)=BUFRIN(INDIC+2)
    PLOTB4(KN)=DIFFER(LDEX)
216 KN=KN+1
    INDIC=INDIC+5
    IF (5000-KN) 217,219,219
219 IF (TIML-TIMU) 218,218,217
217 CALL FILSPA
205 IB2=1
    KN=KN-1
    DO 1004 KXY=1,KN
        IF(PLOTB2(KXY)-PLOTB2(1)) 1005,1004,1005
1004 CONTINUE
        IB2=0
1005 IB4=1
    DO 1006 KXY=1,KN
        IF (PLOTB4(KXY)-PLOTB4(1)) 1007,1006,1007
1006 CONTINUE
        IB4=0
1007 CALL SCALE(PLOTB1,KN,XLEN(J),XMIN,DX)
    IF (IB2+IB4) 1014,12,1014
1014 IF (IB2) 1010,1011,1010
1010 CALL SCALE(PLOTB2,KN,5.0,YMIN2,DY2)
    DO 16 K=1,KN
        PLOTB3(K)=(PLOTB3(K)-YMIN2)*10./ (DY2)
1011 IF (IB4) 1012,1013,1012
1012 CALL SCALE(PLOTB4,KN,5.0,YMIN4,DY4)
1013 IF (IB2) 1040,1041,1040
1040 IF (IUJ) 1101,12,1101
1101 IF (XMODF(IUJ,2)) 1102,1103,1102
1102 CALL LINE(PLOTB1,PLOTB2,KN)
1103 IF (XMODF(IUJ,4) - 2) 1041,1104,1104
1104 CALL LINE(PLOTB1,PLOTB3,KN)
1041 IF (IB4) 1042,1043,1042
1042 IF (XMODF(IUJ,8) - 4) 1043,1105,1105
1105 CALL LINE(PLOTB1,PLOTB4,KN)
1043 CALL AXIS(XSTA,YSTA,4HTIME,4,XLEN(J),0.0,XMIN,DX)
    XSTAX=XSTA-0.5
    IF (JTEST) 11,10,11
    10 IF (IB2) 1020,1021,1020
1020 CALL AXIS(XSTA,YSTA,7HAZIMUTH,7,5.0,90.0,YMIN2,DY2 )
1021 IF (IB4) 1022,12,1022
1022 CALL XAXIS(XSTAX,YSTA,13HAZIMUTH ERROR,13,5.0,90.0,YMIN4,DY4,3)
    GO TO 12

```

```

11 IF (IB2) 1030, 1031, 1030
1030 CALL AXIS(XSTA, YSTA, 9, ELEVATION, 9, 5.0, 90.0, YMIN2, DY2 )
1031 IF (IB4) 1032, 12, 1032
1032 CALL XAXIS(XSTAX, YSTA, 15, ELEVATION ERROR, 15, 5.0, 90.0, YMIN4, DY4, 3)
12 X=XSTA+3.0
   Y=YSTA+3.5
   DO 1050 NANCY=1,5
   NAX=6-NANCY
1050 XLABEL(NANCY)=XLABSR(NAX)
   CALL SYMBL4(X,Y,.21,XLABEL(5),0.0,30)
   CALL PLOT (0.0,8.5,-3)
   IF (INTEST=NGRAPH) 3,13,3
3 CONTINUE
  IZ=1
  DO 14 J=1,3
  IF (IZ) 32,31,32
32 IZ=0
   JSV=J
   GO TO 14
31 IF (XLEN(J)-XLEN(JSV)) 14,14,17
17 JSV =J
14 CONTINUE
   XLEN(JSV)=XLEN(JSV)+4.0
   CALL PLOT(XLEN(JSV),0.0,-3)
2 CONTINUE
  REWIND 6
  REWIND 7
13 PRINT 30
   WRITE OUTPUT TAPE 3,30
30 FORMAT (49H1DISMOUNT TAPE A6 AND PLOT IT, SAVE INPUT TAPE A7)
   PAUSE 77777
   CALL EXIT
END

```


APPENDIX D
MODIFIED AXIS PLOTTING PROGRAM

```
* LIST8
CXAXIS SUBROUTINE XAXIS (X,Y,BCD,NC,SIZE,THETA,YMIN,DY,IPEN)
TH = THETA / 57.29578
N=SIZE+0.50
YB=SINF(TH)
XA=X-0.1*YB
XB=COSF(TH)
XC=X
YA=Y-0.1*XB
YC=Y
CHAR=ABSF(YMIN)
VALUE=ABSF(YMIN+DY)
IF (CHAR-VALUE)5,6,6
5 CHAR=VALUE
6 N1=0
VALUE=10000.
I3=3
14 IF (CHAR-VALUE)15,16,16
15 N1=N1+1
VALUE=VALUE/10.0
GO TO 14
16 DO 20 I=1,N
CALL PLOT(XA,YA,I3)
CALL PLOT(XC,YC,IPEN)
XC=XC+XB
YC=YC+YB
XA=XA+XB
YA=YA+YB
CALL PLOT(XC,YC,IPEN)
20 I3=IPEN
CALL PLOT(XA,YA,IPEN)
XA=XC-.12
YA=YC-.12
XC=XC*XB
YC=YC*YB
N=N+1
DO 30 I=1,N
VALUE=((XC+YC)*DY/10.0)+YMIN
CALL NUMBER(XA,YA,0.10,VALUE,THETA,N1)
XA=XA-XB
YA=YA-YB
XC=XC-XB
30 YC=YC-YB
VALUE=NC/2
XC=X+XB*(SIZE/2.0-0.12*VALUE)-0.3*YB
YC=Y+YB*(SIZE/2.0-0.12*VALUE)-0.46*XB
CALL SYMBL4(XC,YC,0.14,BCD,THETA,NC)
RETURN
END
```

APPENDIX E
TAPE READING SUBROUTINE

READER	ENTRY	READER
	CLA	1,4
	STA	CWORD
	CLA*	2,4
	STD	CWORD
	RTBA	7
	RCHA	CWORD
	TCOA	*
	TEFA	END
	STZ*	3,4
	TRA	4,4
END	CLA	=1
	STO*	3,4
	TRA	4,4
CWORD	IORP	,,
	IOCD	,,
	END	

APPENDIX F

FLOATING POINT CONVERSION SUBROUTINE

*	FAP	
	ENTRY	FLOTER
FLOTER	CAL*	1,4
	ALS	6
	PBT	
	TRA	**7
	CLA	#1
	STO	ZIG
	CAL*	1,4
	ORA	=0770000000000
	COM	
	TRA	**2
	CAL*	1,4
	ORA	=0233000000000
	SLW*	1,4
	CLA	ZIG
	TZE	ZAG
	PXA	**
	FSB*	1,4
	TRA	ZOG
ZAG	PXA	**
	FAD*	1,4
ZOG	STO*	1,4
	TRA	2,4
ZIG	PZE	
	END	

APPENDIX G
FILE SPACING SUBROUTINE

```
*      FAP  
      ENTRY  FILSPA  
FILSPA RTBA  7  
      RCHA  CWORD  
      TCOA  *  
      TEFA  **2  
      TRA   **4  
      TRA   1*4  
CWORD  IORP  **  
      IOCD  **  
      END
```


READY

LD0S203210100000

-62-2863

READY

PS0100000

THIS IS THE ANTENNA TESTING PROGRAM.

DO YOU WISH TO HAVE OUTPUT ON THE ON-LINE PRINTER.

IF SO, HOW OFTEN.

YES0250

TYPE TEST IDENTIFICATION.

SINE AND STEP FUNCTIONS

TYPE TEST PARAMETERS.

90,0,1,100,1,AZSINE,ELSTEP,.02,5,5,3,7.5,

TYPE TEST IDENTIFICATION.

POLY AND IMPULSE FUNCTIONS

TYPE TEST PARAMETERS.

,45,,35,,AZPOLY,ELIMP,7,72.6,-46.49521,12.3,-1.65,.43,
5,10,.5,10,

TYPE TEST IDENTIFICATION.

CONSTANT BIASES

TYPE TEST PARAMETERS.

92.109375,42.890625,,10,100,AZNOT,ELNOT,,,

TYPE TEST IDENTIFICATION.

END OF DEMONSTRATION

TYPE TEST PARAMETERS.

...

DO YOU WISH TO CONTINUE

NO

DO YOU WISH TO REWIND OUTPUT TAPE.

YES

READY

Fig. 1. Sample console communications.

0.9959	90.6241	90.6241	0.0000	0.0000	0.0000	0.0000
1.9959	91.2407	91.2380	-0.0027	0.0000	0.0000	0.0000
2.9959	91.8381	91.8354	-0.0027	0.0000	0.0000	0.0000
3.9959	92.4060	92.4039	-0.0020	0.0000	0.0000	0.0000
4.9959	92.9367	92.9347	-0.0020	0.0000	0.0000	0.0000
5.9959	93.4208	93.4188	-0.0020	2.9999	2.9999	0.0000
6.9959	93.8507	93.8493	-0.0013	2.9999	2.9999	0.0000
7.9959	94.2201	94.2187	-0.0013	2.9999	2.9999	0.0000
8.9959	94.5229	94.5215	-0.0013	2.9999	2.9999	0.0000
9.9959	94.7543	94.7536	-0.0006	2.9999	2.9999	0.0000
10.9959	94.9108	94.9102	-0.0006	2.9999	2.9999	0.0000
11.9959	94.9898	94.9891	-0.0006	2.9999	2.9999	0.0000
12.9959	94.9898	94.9898	0.0000	5.9999	5.9999	0.0000
13.9959	94.9115	94.9122	0.0006	5.9999	5.9999	0.0000
14.9959	94.7557	94.7563	0.0006	5.9999	5.9999	0.0000
15.9959	94.5249	94.5256	0.0006	5.9999	5.9999	0.0000
16.9959	94.2228	94.2242	0.0013	5.9999	5.9999	0.0000
17.9959	93.8541	93.8555	0.0013	5.9999	5.9999	0.0000
18.9959	93.4243	93.4263	0.0020	5.9999	5.9999	0.0000
19.9959	92.9409	92.9429	0.0020	5.9999	5.9999	0.0000
20.9959	92.4108	92.4128	0.0020	8.9998	8.9998	0.0000
21.9959	91.8429	91.8450	0.0020	8.9998	8.9998	0.0000
22.9959	91.2455	91.2483	0.0027	8.9998	8.9998	0.0000
23.9959	90.6289	90.6310	0.0020	8.9998	8.9998	0.0000
24.9959	90.0020	90.0048	0.0027	8.9998	8.9998	0.0000
25.9959	89.3600	89.3627	0.0027	8.9998	8.9998	0.0000
26.9959	88.7441	88.7461	0.0020	8.9998	8.9998	0.0000
27.9959	88.1474	88.1494	0.0020	11.9998	11.9998	0.0000
28.9959	87.5795	87.5816	0.0020	11.9998	11.9998	0.0000
29.9959	87.0501	87.0522	0.0020	11.9998	11.9998	0.0000
30.9959	86.5674	86.5695	0.0020	11.9998	11.9998	0.0000
31.9959	86.1389	86.1403	0.0013	11.9998	11.9998	0.0000
32.9959	85.7709	85.7723	0.0013	11.9998	11.9998	0.0000
33.9959	85.4701	85.4708	0.0006	11.9998	11.9998	0.0000
34.9959	85.2401	85.2415	0.0013	11.9998	11.9998	0.0000
35.9959	85.0856	85.0863	0.0006	14.9997	14.9997	0.0000
36.9959	85.0087	85.0087	0.0000	14.9997	14.9997	0.0000
37.9959	85.0101	85.0101	0.0000	14.9997	14.9997	0.0000
38.9959	85.0904	85.0904	0.0000	14.9997	14.9997	0.0000
39.9959	85.2484	85.2477	-0.0006	14.9997	14.9997	0.0000
40.9959	85.4811	85.4798	-0.0013	14.9997	14.9997	0.0000
41.9959	85.7846	85.7833	-0.0013	14.9997	14.9997	0.0000
42.9959	86.1354	86.1334	-0.0020	17.9997	17.9997	0.0000
43.9959	86.5859	86.5846	-0.0013	17.9997	17.9997	0.0000
44.9959	87.0707	87.0687	-0.0020	17.9997	17.9997	0.0000
45.9959	87.6022	87.6001	-0.0020	17.9997	17.9997	0.0000
46.9959	88.1707	88.1687	-0.0020	17.9997	17.9997	0.0000
47.9959	88.7688	88.7660	-0.0027	17.9997	17.9997	0.0000
48.9959	89.3854	89.3833	-0.0020	17.9997	17.9997	0.0000
49.9959	90.0123	90.0096	-0.0027	17.9997	17.9997	0.0000
50.9959	90.6234	90.6214	-0.0020	20.9996	20.9996	0.0000
51.9959	91.2407	91.2380	-0.0027	20.9996	20.9996	0.0000
52.9959	91.8381	91.8354	-0.0027	20.9996	20.9996	0.0000
53.9959	92.4060	92.4039	-0.0020	20.9996	20.9996	0.0000
54.9959	92.9367	92.9347	-0.0020	20.9996	20.9996	0.0000
55.9959	93.4208	93.4188	-0.0020	20.9996	20.9996	0.0000
56.9959	93.8507	93.8493	-0.0013	20.9996	20.9996	0.0000
57.9959	94.2201	94.2187	-0.0013	23.9996	23.9996	0.0000
58.9959	94.5229	94.5215	-0.0013	23.9996	23.9996	0.0000
59.9959	94.7543	94.7536	-0.0006	23.9996	23.9996	0.0000
60.9959	94.9108	94.9102	-0.0006	23.9996	23.9996	0.0000
61.9959	94.9898	94.9891	-0.0006	23.9996	23.9996	0.0000
62.9959	94.9898	94.9898	0.0000	23.9996	23.9996	0.0000
63.9959	94.9115	94.9122	0.0006	23.9996	23.9996	0.0000
64.9959	94.7557	94.7563	0.0006	23.9996	23.9996	0.0000
65.9959	94.5249	94.5256	0.0006	26.9995	26.9995	0.0000
66.9959	94.2228	94.2242	0.0013	26.9995	26.9995	0.0000
67.9959	93.8541	93.8555	0.0013	26.9995	26.9995	0.0000
68.9959	93.4243	93.4263	0.0020	26.9995	26.9995	0.0000
69.9959	92.9409	92.9429	0.0020	26.9995	26.9995	0.0000
70.9959	92.4108	92.4128	0.0020	26.9995	26.9995	0.0000
71.9959	91.8429	91.8450	0.0020	26.9995	26.9995	0.0000
72.9959	91.2455	91.2483	0.0027	29.9995	29.9995	0.0000
73.9959	90.6289	90.6310	0.0020	29.9995	29.9995	0.0000
74.9959	90.0020	90.0048	0.0027	29.9995	29.9995	0.0000
75.9959	89.3600	89.3627	0.0027	29.9995	29.9995	0.0000
76.9959	88.7441	88.7461	0.0020	29.9995	29.9995	0.0000
77.9959	88.1474	88.1494	0.0020	29.9995	29.9995	0.0000
78.9959	87.5795	87.5816	0.0020	29.9995	29.9995	0.0000
79.9959	87.0501	87.0522	0.0020	29.9995	29.9995	0.0000
80.9959	86.5674	86.5695	0.0020	32.9994	32.9994	0.0000
81.9959	86.1389	86.1403	0.0013	32.9994	32.9994	0.0000
82.9959	85.7709	85.7723	0.0013	32.9994	32.9994	0.0000
83.9959	85.4701	85.4708	0.0006	32.9994	32.9994	0.0000
84.9959	85.2401	85.2415	0.0013	32.9994	32.9994	0.0000
85.9959	85.0856	85.0863	0.0006	32.9994	32.9994	0.0000
86.9959	85.0087	85.0087	0.0000	32.9994	32.9994	0.0000
87.9959	85.0101	85.0101	0.0000	35.9994	35.9994	0.0000
88.9959	85.0904	85.0897	-0.0006	35.9994	35.9994	0.0000
89.9959	85.2484	85.2477	-0.0006	35.9994	35.9994	0.0000
90.9959	85.4811	85.4798	-0.0013	35.9994	35.9994	0.0000
91.9959	85.7846	85.7833	-0.0013	35.9994	35.9994	0.0000
92.9959	86.1354	86.1334	-0.0020	35.9994	35.9994	0.0000
93.9959	86.5859	86.5846	-0.0013	35.9994	35.9994	0.0000
94.9959	87.0707	87.0687	-0.0020	35.9994	35.9994	0.0000
95.9959	87.6022	87.6001	-0.0020	38.9994	38.9994	0.0000
96.9959	88.1707	88.1687	-0.0020	38.9994	38.9994	0.0000
97.9959	88.7688	88.7660	-0.0027	38.9994	38.9994	0.0000
98.9959	89.3854	89.3833	-0.0020	38.9994	38.9994	0.0000
99.9959	90.0123	90.0096	-0.0027	38.9994	38.9994	0.0000

Fig. 2. Sample decimal on-line output. (See Fig. 1, Sine and Step functions run.)

-62-2865									
0.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
1.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
2.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
3.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
4.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
5.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
6.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
7.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
8.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000
9.9959	92.1093	0000406000	0000406000	42.8906	0000172000	0000172000	00000	00000	00000

Fig. 3. Sample on-line octal output. (See Fig. 1, Constant Biases run.)

-62-2866									
* DATA									
2									
10									
10									

Fig. 4. Sample input deck to 7094 print program.

SINE AND STEP FUNCTIONS

0.99600	90.62416	90.62416	0.	0.	0.	0.	0.	0.	0.
1.03600	90.64800	90.64613	0.	0.	0.	0.	0.	0.	0.
1.07600	90.67360	90.67085	0.	0.	0.	0.	0.	0.	0.
1.11600	90.69832	90.69626	0.	0.	0.	0.	0.	0.	0.
1.15600	90.72372	90.72098	0.	0.	0.	0.	0.	0.	0.
1.19600	90.74844	90.74570	0.	0.	0.	0.	0.	0.	0.
1.23600	90.77316	90.77041	0.	0.	0.	0.	0.	0.	0.
1.27600	90.79788	90.79513	0.	0.	0.	0.	0.	0.	0.
1.31600	90.82260	90.82054	0.	0.	0.	0.	0.	0.	0.
1.35600	90.84732	90.84526	0.	0.	0.	0.	0.	0.	0.
1.39600	90.87204	90.86998	0.	0.	0.	0.	0.	0.	0.
1.43600	90.89676	90.89470	0.	0.	0.	0.	0.	0.	0.
1.47600	90.92148	90.91942	0.	0.	0.	0.	0.	0.	0.
1.51600	90.94620	90.94414	0.	0.	0.	0.	0.	0.	0.
1.55600	90.97091	90.96885	0.	0.	0.	0.	0.	0.	0.
1.59600	90.99563	90.99357	0.	0.	0.	0.	0.	0.	0.
1.63600	91.02035	91.01829	0.	0.	0.	0.	0.	0.	0.
1.67600	91.04507	91.04301	0.	0.	0.	0.	0.	0.	0.
1.71600	91.06979	91.06773	0.	0.	0.	0.	0.	0.	0.
1.75600	91.09451	91.09245	0.	0.	0.	0.	0.	0.	0.
1.79600	91.11923	91.11717	0.	0.	0.	0.	0.	0.	0.
1.83600	91.14395	91.14189	0.	0.	0.	0.	0.	0.	0.
1.87600	91.16867	91.16661	0.	0.	0.	0.	0.	0.	0.
1.91600	91.19339	91.19133	0.	0.	0.	0.	0.	0.	0.
1.95600	91.21811	91.21605	0.	0.	0.	0.	0.	0.	0.
1.99600	91.24283	91.24077	0.	0.	0.	0.	0.	0.	0.
2.03600	91.26755	91.26549	0.	0.	0.	0.	0.	0.	0.
2.07600	91.29227	91.29021	0.	0.	0.	0.	0.	0.	0.
2.11600	91.31699	91.31493	0.	0.	0.	0.	0.	0.	0.
2.15600	91.34171	91.33965	0.	0.	0.	0.	0.	0.	0.
2.19600	91.36643	91.36437	0.	0.	0.	0.	0.	0.	0.
2.23600	91.39115	91.38909	0.	0.	0.	0.	0.	0.	0.
2.27600	91.41587	91.41381	0.	0.	0.	0.	0.	0.	0.
2.31600	91.44059	91.43853	0.	0.	0.	0.	0.	0.	0.
2.35600	91.46531	91.46325	0.	0.	0.	0.	0.	0.	0.
2.39600	91.48999	91.48793	0.	0.	0.	0.	0.	0.	0.
2.43600	91.51471	91.51265	0.	0.	0.	0.	0.	0.	0.
2.47600	91.53943	91.53737	0.	0.	0.	0.	0.	0.	0.
2.51600	91.56415	91.56209	0.	0.	0.	0.	0.	0.	0.
2.55600	91.58887	91.58681	0.	0.	0.	0.	0.	0.	0.
2.59600	91.61359	91.61153	0.	0.	0.	0.	0.	0.	0.
2.63600	91.63831	91.63625	0.	0.	0.	0.	0.	0.	0.
2.67600	91.66303	91.66097	0.	0.	0.	0.	0.	0.	0.
2.71600	91.68775	91.68569	0.	0.	0.	0.	0.	0.	0.
2.75600	91.71247	91.71041	0.	0.	0.	0.	0.	0.	0.
2.79600	91.73719	91.73513	0.	0.	0.	0.	0.	0.	0.
2.83600	91.76191	91.75985	0.	0.	0.	0.	0.	0.	0.
2.87600	91.78663	91.78457	0.	0.	0.	0.	0.	0.	0.
2.91600	91.81135	91.80929	0.	0.	0.	0.	0.	0.	0.
2.95600	91.83607	91.83401	0.	0.	0.	0.	0.	0.	0.
2.99600	91.86079	91.85873	0.	0.	0.	0.	0.	0.	0.
3.03600	91.88551	91.88345	0.	0.	0.	0.	0.	0.	0.
3.07600	91.91023	91.90817	0.	0.	0.	0.	0.	0.	0.
3.11600	91.93495	91.93289	0.	0.	0.	0.	0.	0.	0.
3.15600	91.95967	91.95761	0.	0.	0.	0.	0.	0.	0.
3.19600	91.98439	91.98233	0.	0.	0.	0.	0.	0.	0.
3.23600	91.99911	91.99705	0.	0.	0.	0.	0.	0.	0.
3.27600	92.00000	92.00000	0.	0.	0.	0.	0.	0.	0.
3.31600	92.00000	92.00000	0.	0.	0.	0.	0.	0.	0.

Fig. 5. Sample output of 7094 print program.

* DATA										-62-2868	
8											
SINE AND STEP FUNCTIONS											
0	.03				1	100	8	1			
SINE AND STEP FUNCTIONS											
0	.03				1	100	8	4			
SINE AND STEP FUNCTIONS											
1	.006				4	6	8	1			
SINE AND STEP FUNCTIONS											
1	.008				4	6	8	4			
POLY AND IMPULSE FUNCTIONS											
0	.02				7	70	8	1			
POLY AND IMPULSE FUNCTIONS											
0	.02				1	85	8	1			
POLY AND IMPULSE FUNCTIONS											
1	.008				4	6	8	1			
POLY AND IMPULSE FUNCTIONS											
1	.008				4	6	8	4			

Fig. 6. Sample input deck to 7094 plot program.

SINE AND STEP FUNCTIONS

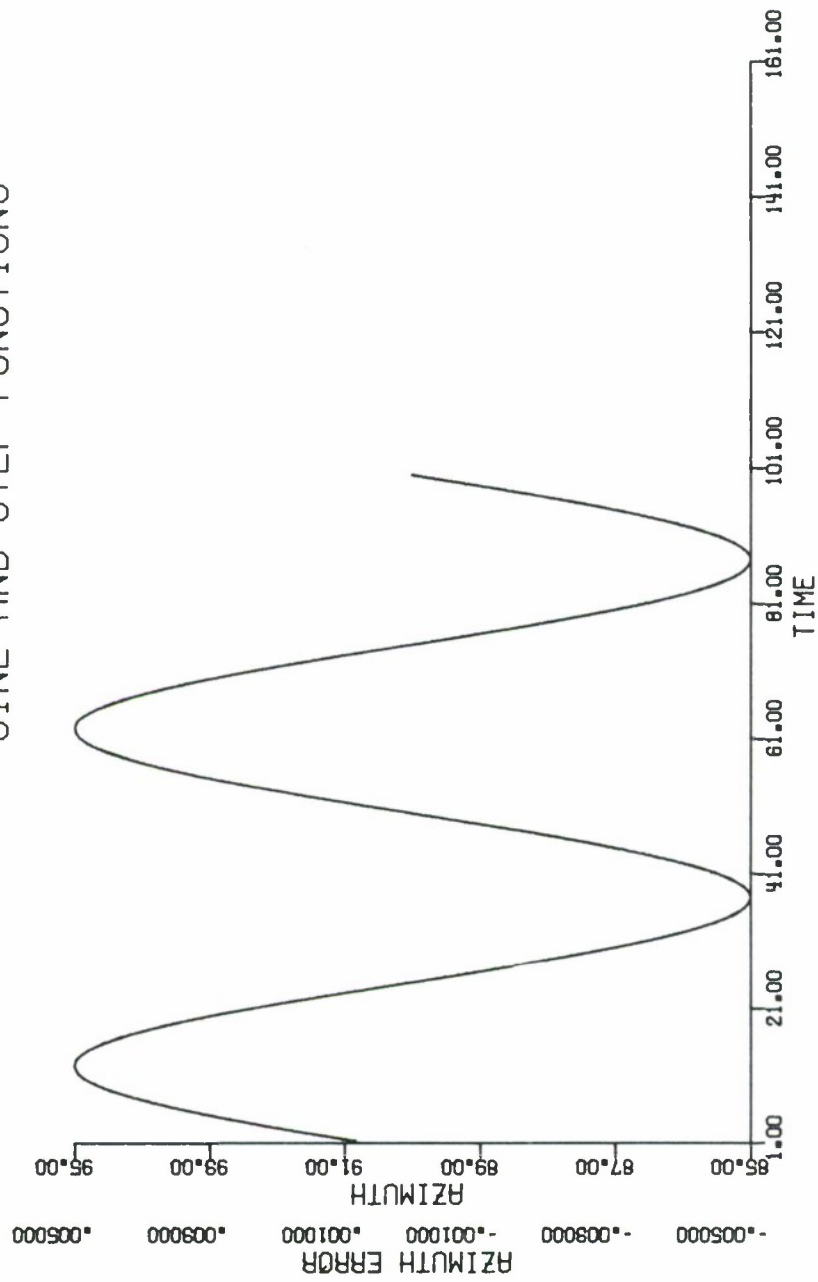


Fig. 7. Azimuth angle (sine function).

SINE AND STEP FUNCTIONS

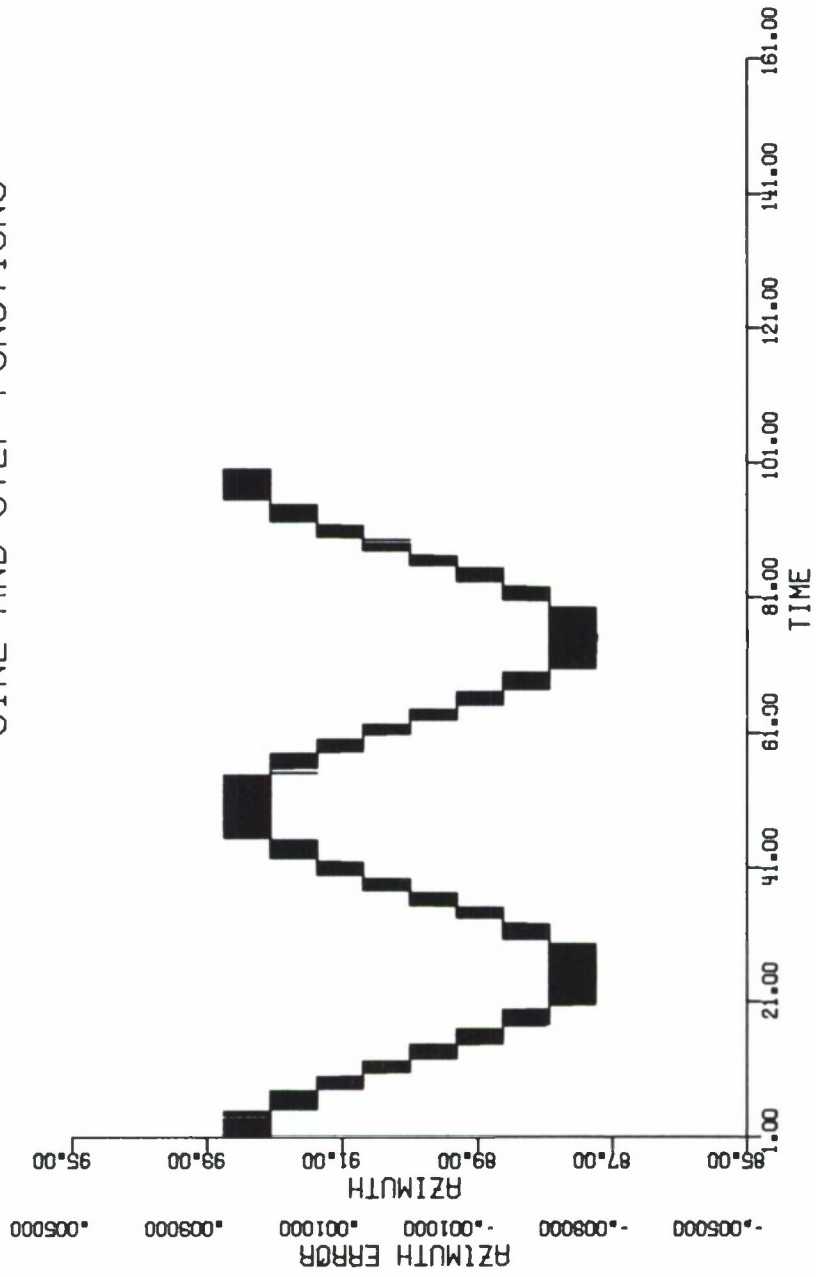


Fig. 8. Azimuth error (sine function).

SINE AND STEP FUNCTIONS

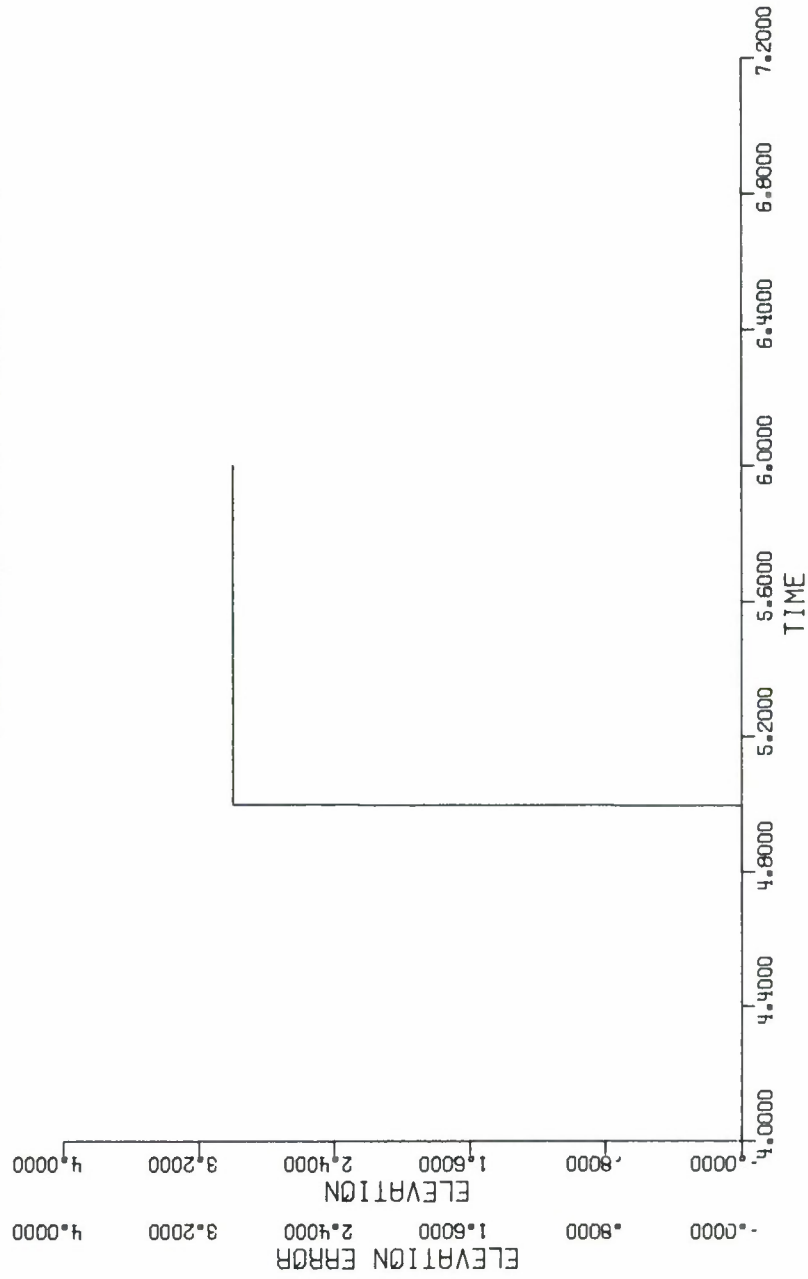


Fig. 9. Elevation angle (step function).

SINE AND STEP FUNCTIONS

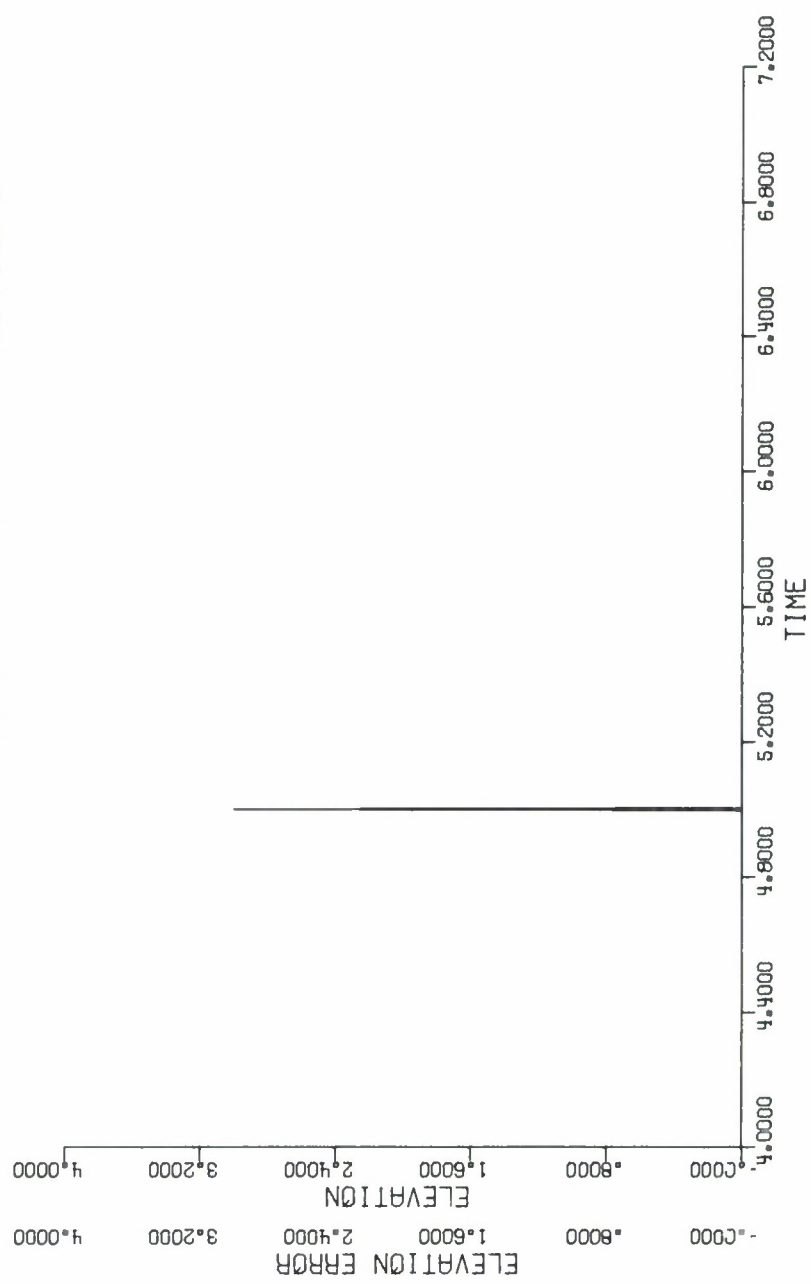


Fig. 10. Elevation error (step function).

POLY AND IMPULSE FUNCTIONS

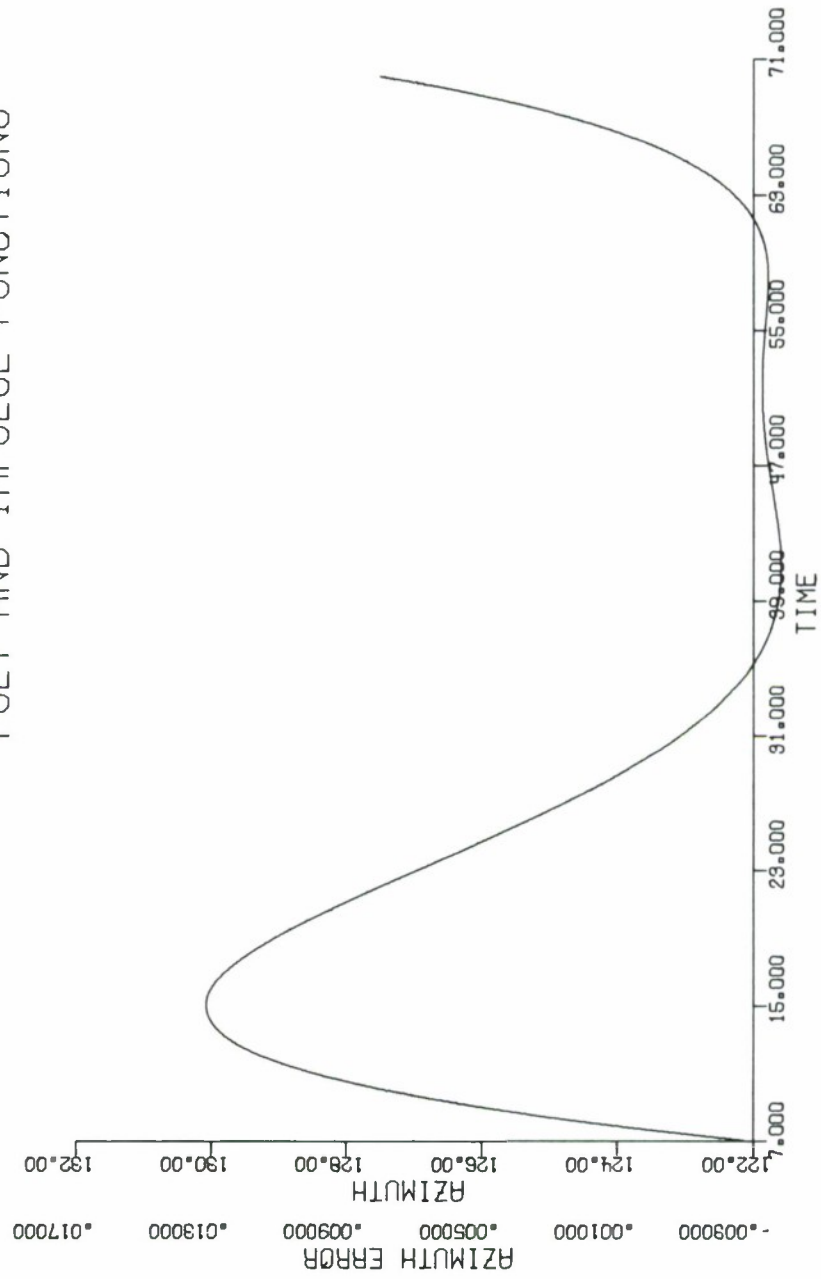


Fig. 11. Azimuth angle (5th order polynomial).

POLY AND IMPULSE FUNCTIONS

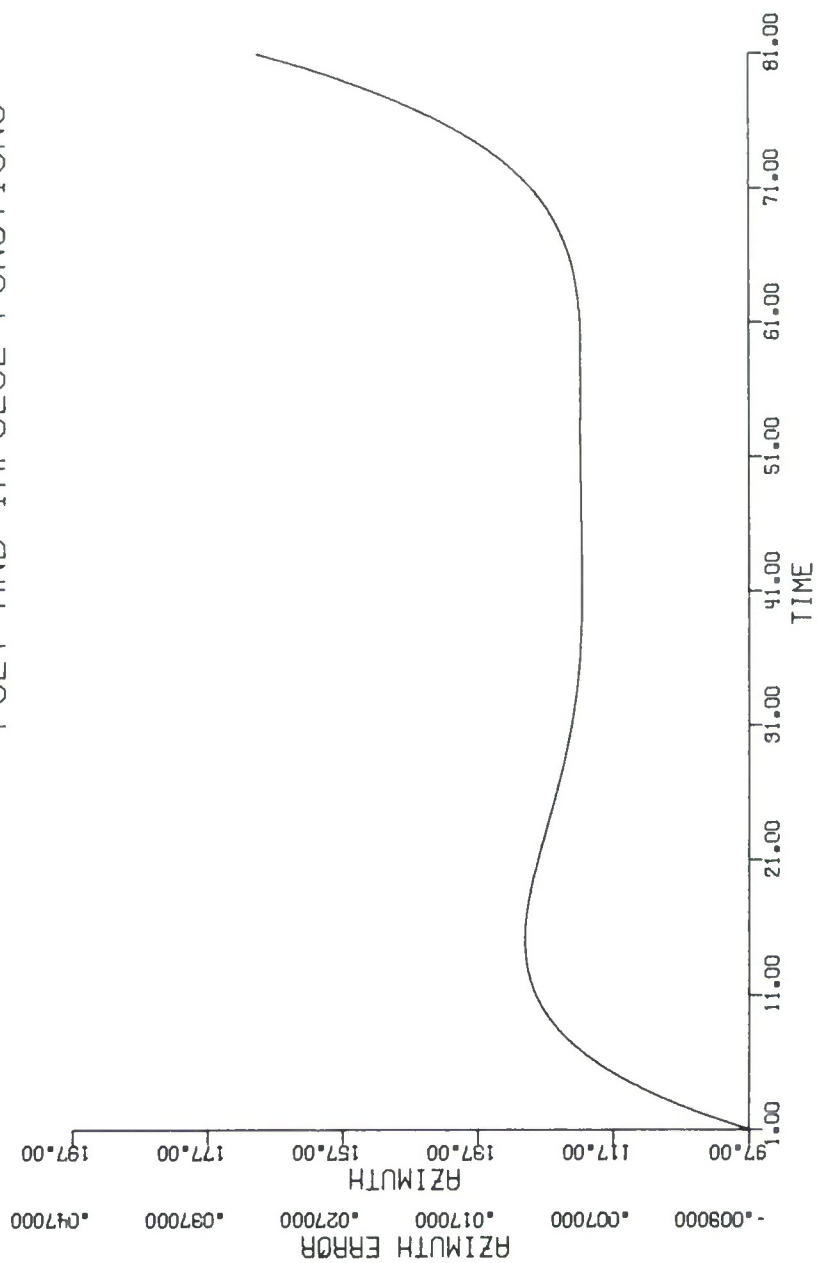


Fig. 12. Azimuth angle (5th order polynomial). Plotted with different time limits.

-62-2875

POLY AND IMPULSE FUNCTIONS

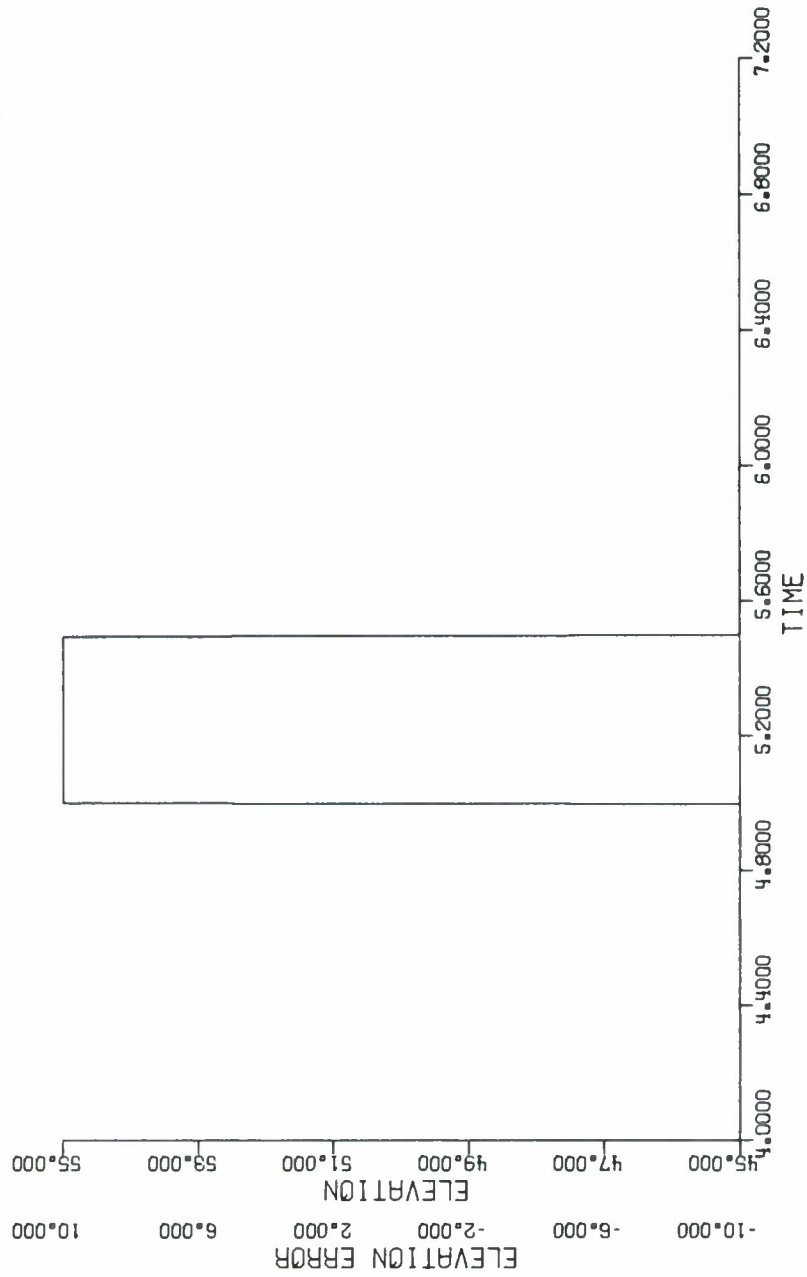


Fig. 13. Elevation angle (impulse function).

POLY AND IMPULSE FUNCTIONS

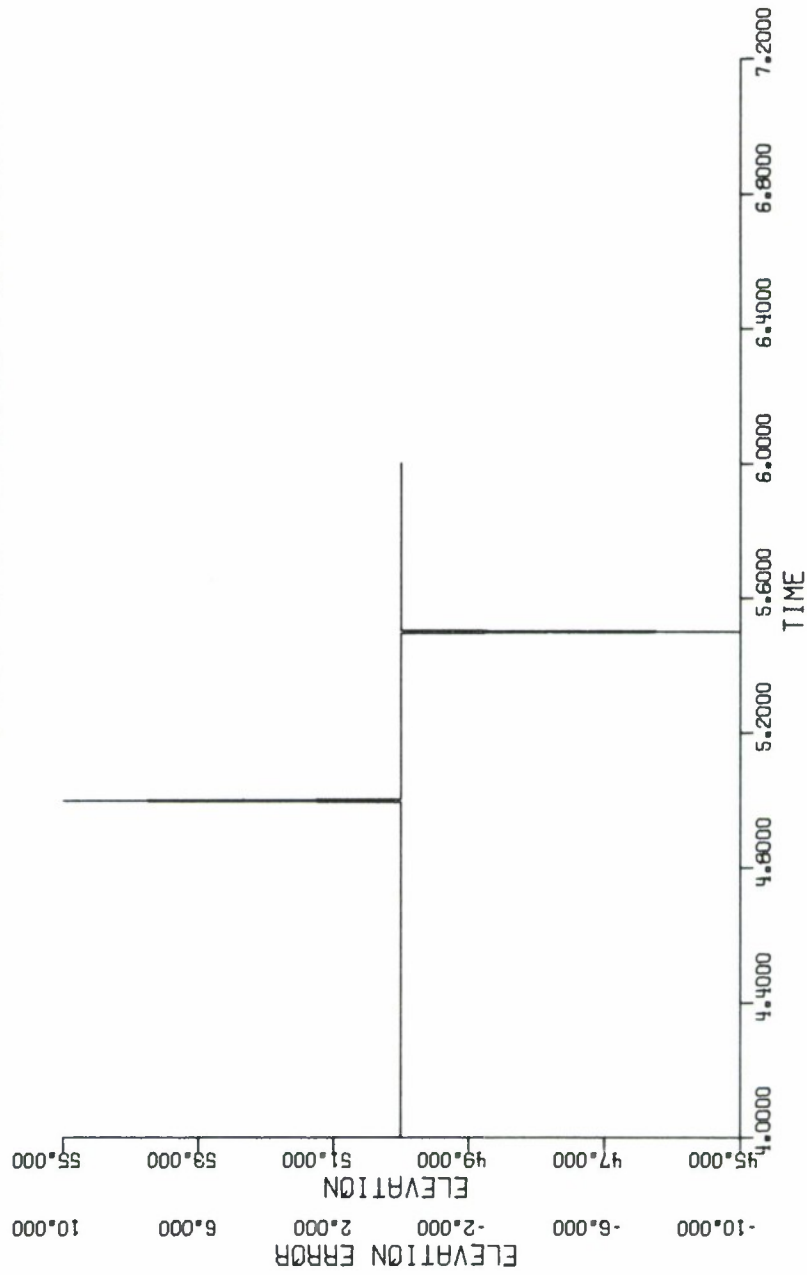


Fig. 14. Elevation error (impulse function).

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The facilities available for testing the performance of the Haystack servo system using the Univac 490 digital computer are described. Sine, step, impulse, and polynomial inputs may be applied to the system. Operating instructions and examples of inputs and outputs from the various programs are given. A fairly detailed description of the program logic is provided and complete listing are included for all non-library programs.

14.

KEY WORDS

LINK A

LINK B

LINK C

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 Servo Systems Warning Systems
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